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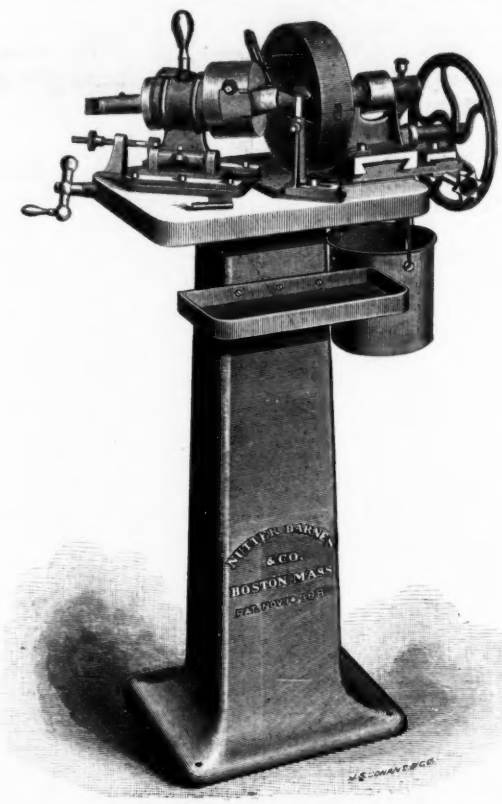
Improved Twist Drill Grinder.

The engravings on this page and on page 2 represent a machine for grinding twist drills, now being put on the market by Hill, Clarke & Co., Boston, Mass.

It appears to be simple, and easy of adjustment. The grinding-wheel is seven inches in diameter, and has a reciprocating movement of ¾ of an inch, which gives a uniform wear to the wheel. It is run in a close case, and supplied with water from a pump which works automatically. The frame on which the wheel is mounted has a swivel motion, by which almost any desired angle can be obtained.

With this machine the chuck is not depended upon to hold the drill central, as it is supported at or near the point by a side guide-rest while being ground, which insures its being ground true and central from the outside. The drill being placed in the chuck so as to bring the cutting-lips in a proper position with the grinding-wheel, it is fastened to the chuck jaws, and the chuck and eccentric sleeve are locked together; they are then rotated by hand bodily on the guide-rest, and as the drill rises and falls on the rest, at the same time it receives a lateral motion, which gives the proper clearance to the back of the drill. As soon as the lip operated on is properly ground, the drill should be drawn from the wheel—the back-and-forth movement being determined by means of a gauge on the screw—the chuck sleeve and eccentric are unlocked, and the chuck turned half around by means of an index. This movement brings the other lip of the drill in position to be ground. The wheel should run 2,800 revolutions per minute.



TWIST DRILL GRINDER.

New Heavy Milling Machine.

We present herewith an engraving showing a new design of milling machine intended for heavy work in manufacturing operations, which has recently been brought out by Eynon & Ingersoll, of Cleveland, Ohio.

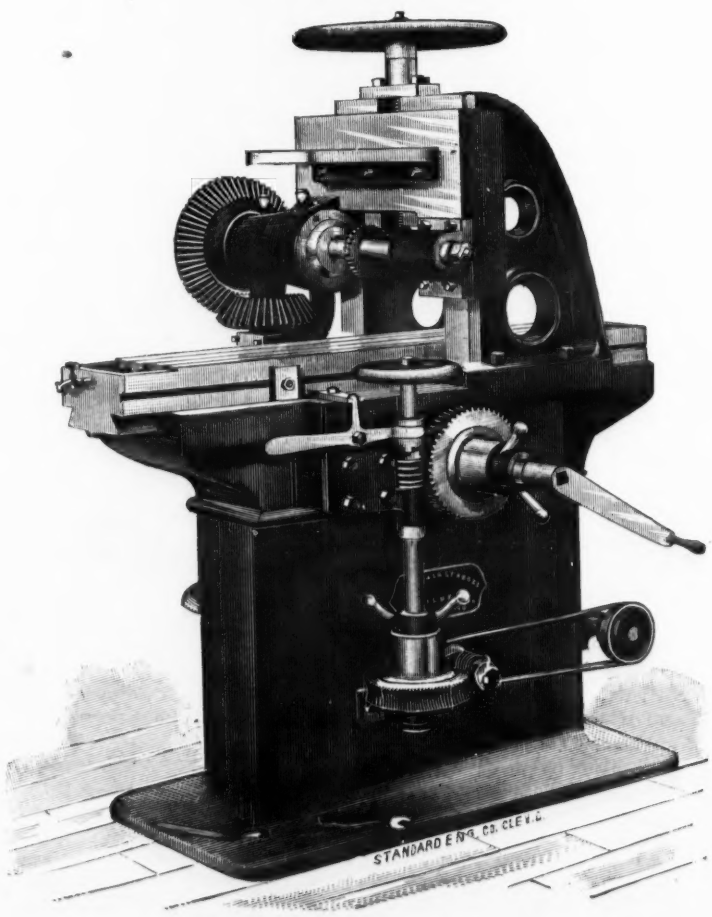
The table has an automatic feed motion, the arrangement of which is very clearly shown in the cut, and is provided with an adjustable stop which can be set at any point along the table. There is also a hand movement for the table, which can be operated either directly by the crank handle shown, for quick return, or by the small hand wheel on top of the vertical worm shaft, when it is desired to feed by hand. The sliding head which carries the spindle can be fed down while the machine is running, by means of the large hand wheel on top, and has a vertical movement of 12 inches.

The spindle, which is of hammered steel, is 4 inches diameter, is provided with an "anti-friction" taper journal so arranged as to provide for easy adjustment for wear, and is powerfully geared. The arbor, which is made heavy, to secure ample rigidity for taking heavy cuts, with gangs of cutters, fits into a tapered hole in the spindle 7 inches in length, and has an outer bearing 2 inches diameter and 5 inches long.

It will be noticed that the table is quite heavy, has a bearing nearly equal to its length, and that the machine as a whole is of a heavy and substantial design, apparently well calculated for the work it is intended to do.

A shelf is provided above the arbor, upon which a vessel containing oil or soda water may be placed, and provision is made for drawing it off through the cock shown at the end of the table.

The machine is built in sizes ranging from 12 inches square between housings with 6 foot table, to 24 inches square with 10 foot table, and has been designed especially for such work as milling the beds of lathes, valve seats, ends of large connecting-rods, boxes, test pieces, cutting key-ways, slotting, surfacing, and other kinds of general machine shop work to which milling operations are adapted.



NEW HEAVY MILLING MACHINE.

About Belts and Pulleys.

BY FRANK H. RICHARDS.

FIRST PAPER.

SOME FAMILIAR FACTS—SOME NOT SO FAMILIAR.

In the shop and in the trade some topics are so familiar that everybody is supposed to know all about them. This, it is safe to say, is never the fact. There is always much to be said—and then much will be left unsaid—concerning the things that we know all about. The loss resulting from tight belts is not always known, or, if known, is not generally appreciated, or the practice would be less prevalent. The items of loss from this source are numerous. Where the size of the belt and the pulley surface is ample, the fact of loss from unnecessary tension is easily demonstrable, although it may be difficult to compute the amount. The more frequent and serious trouble is in trying to get a belt to do too much. Here, first, there is the loss which is supposed to be the gain; that is, the loss in the cost of belting. It is, perhaps, not fair to attribute insufficient belts to pinching economy. Carelessness or incompetence or guesswork in computing belt capacity is generally to blame. When we try to make a belt transmit more power than it is properly capable of the belt is stretched out of shape, often becomes crooked from this cause, one edge yielding more than the other, it tears out at the lace holes and must soon be replaced by another, while in a place where it was not over-strained it could easily have lasted twice or four times as long. Then, resulting from the tight belt, there is the additional friction upon the shafting journals, constantly absorbing unnecessary power, causing inordinate wear, and demanding renewal of shafting or boxes long before it is due. It is astonishing how long a line shaft will run if not in any way over-strained, and if looked after with reasonable care. I know a line which has been in pretty constant use thirty-five years. That is long enough. The growth and changes of business do not often give one a chance to last as long as that in this country. It is more astonishing how short a time a shaft is sometimes run under other conditions before demanding renewal. I have known shafts worn in the journals to one-half the diameter, and twisted off in less than a year. One shaft which I once found I carry in my mind as an admirable sample combination of all bad conditions. Of course it came to a bad end. The shaft was too small, to begin with; the driving pulley was on the end outside the hanger; the pulling side of the belt was on the top; the belt was too tight; rigid box in the hanger; shaft out of line and out of level; running in excessive heat, being over the back of the boiler; covered with gritty dust; insufficiently oiled, a so-called automatic oiling device being depended upon; the journal inaccessible when the shaft was turning, and forgotten when the shaft was still. Automatic oilers, like all other automatic devices, are incomplete and unreliable if they have not some way of telling when they cease to operate.

Besides when the belt is insufficient for the work it has to do, another frequent reason for carrying tight belts is on account of the improper condition of the surface of either the belt or the pulley. Pulleys may

become too smooth and polished for the belt to adhere to properly, and where they become so by use, it of course always tells of slipping belts. The best driving surface for a pulley is the surface as a tool leaves it with a broad scraping cut. Belts once in good condition, and that are not looked after, will not necessarily remain so. We might say that, through the mere perversity of inanimate things they would necessarily get worse. Belts often run near ceilings, or in hot places, and become hard and dry and dusty, and incapable of doing one-half what they should. Some, again—usually small belts—run close to dripping hangers, or in places where they become saturated, and the pulleys dripping and slippery with oil. I have often used powdered chalk to absorb the oil in such cases. New belts are, of course, always dry and hard, and need to be oiled and softened before they are ready to drive. The prevalent custom is to ignore this. The new belt is got and put on and started, and if it will not drive it is tightened up until it will. They begin to oil the belt when they think of it, or when they have time, or when compelled to do something as a last resort to make the belt do its work.

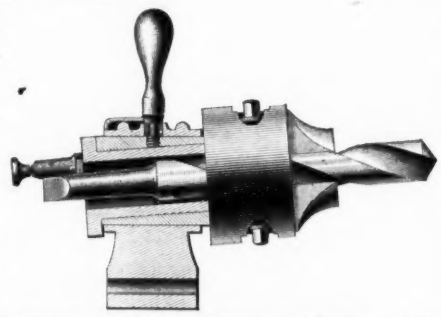
I have learned much of the little that I know by the aid of rough-and-ready experiments, have tested and proved many theories, have upset many of my own. What I offer now neither proves nor disproves anything that I know of, but it may serve to call the attention of some to the important subject of belt surface, and perhaps encourage more instructive and careful trials by others.

I have a piece of new belt $1\frac{1}{4}''$ wide, light and not very hard, and in this respect not so bad to begin with as the average new belt. Then I have a pulley 10″ diameter that I fix up in the vise. The surface of the pulley was finished in the lathe with a file, but it has laid away and got rusty all over. I oil it well and wipe it off clean, and it presents a surface very favorable for belt adhesion. Now I take the piece of new belt and tie a weight of one pound at one end, and this weight stays there through all the trials. On the other end, after weighing it, I tie a basket into which I can put weights as required. First I lay the belt over the pulley with the hair side in contact with it, and I place weights in the basket until the belt slips. The weight, including weight of basket, is $2\frac{3}{4}$ pounds. I now turn the belt over and try it with the flesh side to the pulley, and it takes $9\frac{1}{2}$ pounds to slip the belt. I then take the belt and oil it well on both sides, rubbing and working the oil in, softening the belt, but leaving the surfaces finally dry. Then upon trying it again it takes 6 pounds to make the belt slip upon the hair side, and 14 pounds upon the flesh side. I then take some hard soap and rub over the flesh side of the belt, rubbing it into the whole surface, and wiping off all that I can. Here the weight to make the belt slip can hardly be stated as a fixed quantity. I put it at 11 to 15 pounds. It begins to crawl just perceptibly at 11, and it does not slip very fast at 15. I dust the belt and pulley with fine ashes, and the belt slips at 8 pounds. I clean the soap and ashes off, and oil the belt and pulley to excess, and the belt slips at 5 pounds. I wipe the oil off as thoroughly as I can, and the belt gets dry by absorption. I put on a lot of finely powdered rosin, and the belt slips as easily as with the ashes. I warm the pulley to about 120° Fahr. by rolling it in water, and I cannot make the belt slip with 30 pounds weight. The belt is not cemented on; it unrolls from the pulley without perceptible adhesion, but the rosin on the pulley is slightly sticky when touched with the finger.

Mr. Harris Tabor, some eight or nine years ago, gave to the readers of the AMERICAN MACHINIST an account of some primitive experiments with a belt and pulley similar to these; but his trials, I think, were for exhibiting another line of facts, and had no reference to the condition of the belt surface.

So far as I know, nothing about belts has been more discussed, or, at least, talked about, than as to the proper side of the belt to use to the pulley. I think the matter has never been thoroughly tried or authoritatively settled, although the majority now use the hair side to the pulley. This is probably one of those epidemics of fashion which sometimes have as much to do with determining mechanical practice as they have in shaping feminine attire. I confess to a weakness for using the hair side outward, and would personally always do so, if for no other reason, because it looks so much better. I have watched belts, I suppose, for twenty years, in quest of superior results from turning them over, and I have not found any.

I find a plenty of men in the shop—and one would be a plenty, but I mean many—who do not understand the action of the crowning faced pulley upon the belt that it carries, whereby the belt is kept central upon the pulley. For instance, I have encountered a number who cannot see why a belt should crowd toward the near ends of two shafts that are not parallel, and yet should go toward the high side or larger diameter of the pulley. So such a simple thing as this it is worth while to tell again, for the sake of those who do not know and would like to, and not for those who know it all. There is another thing to be said about these repeated rehearsals of first principles, even for those who long ago learned them. A familiarity with different modes of stating these things gives facility in communicating them to the learners, and so promotes the general diffusion of essential knowledge.



DETAIL OF TWIST DRILL GRINDER.—SEE PAGE 1.

It is said that 100,000 tons of coal are used yearly along the Panama canal. The smokeless Welch coal is now almost exclusively used. The use of anthracite coal has been advised, which leaves the United States collieries a chance to compete.

Some Stray Kinks.

BY C. L. REDFIELD.

With the area and diameter of any circle known, required a simple graphical method of finding the area due to any other diameter or a diameter due to any other area.

Suppose we take the diameter 2 with the area 3.1416 as the known quantity from which to calculate all others. Any other diameter and area may be chosen, but this one is the easiest to remember. Draw the indefinite straight line A B, Fig. 1, and with a diameter equal to 3.1416 draw the semi-circumference A D C. With a radius equal 2 and with A as a center, cut the semi-circumference A D C in D. Through D erect the perpendicular H E, then will the distance A E be a constant for every diameter and area. Let it be required to find by this diagram a diameter that has an area equal 5. Lay off A F=5 and draw the semi-circumference A G F, then will the distance A G be the required diameter. If the diameter is given and the area required, take A as a center, and with the given diameter as a radius, cut the line H E in G. Bisect the line A G at right angles with the line cutting A B in K, then will K be the center of a circle passing through A and G, and its diameter, A F, will be the required area.

This diagram is susceptible of a great variety of applications. The diameters on the line A B may be areas, capacities, weights, tensile strengths, or in fact anything that is made up of area and a constant quantity. The distances from A to the line H E are always diameters, sides of a square, or some constant component of area. The distance A E is different for each kind of proposition, but is constant for every proposition of the same kind. If we say that a bar of 1″ round iron has a safe tensile strength of 7,000 pounds, then we lay off A F=7, draw the arc on this diameter and lay off A G=1. The position of G gives the location of the line H E, from which the tensile strength for any diameter may be found. A diamter A D will have a tensile strength A C.

The advantage of this diagram lies in the fact that it is impossible to remember all areas, weights, strengths, etc., while it is comparatively easy to remember one out of each table. With this one known, it matters not whether the tables are at hand or not, as it is comparatively easy to find any other without calculation or liability of error.

It is a well-known geometrical fact that the angle within a semi-circumference is a right angle. Pattern makers may take advantage of this in the making of core-boxes, in the manner shown in Fig. 2. If the core-box has been cut out accurately, then the square will touch at three places—the two edges and a point in the curve. If it touches at only two places, one being on the curve, then it is not cut out deep enough; if it touches only at the two edges, then it is cut too deep by the amount of clearance between the corner and the curve. By giving the square an oscillation, to make the corner sweep the entire surface of the curve, the accuracy of the curve at that point may be ascertained, and by trying at several points the truth of the whole box may be determined. The square may thus be made to take the place of a templet in the making of core-boxes, with the advantage that the square will fit any size, while a templet only fits one. There is an opportunity here for some one to get up a core-box plane that will produce any semi-circumference accurately and quickly. The only care that would have to be exercised by the workman would be the placing of two parallel metal strips as shown at a and b. These strips are of course not necessary when simply using the square to test the accuracy of the work, but would be necessary in the use of a core-box plane made on this principle.

The setting of an engine valve generally has a halo of mystery thrown about it. Especially is this the case where the "setter" is a man who really has very little knowledge of valve motions, but who has learned some kink which he regards as a momentous secret, and which to give away would be little short of criminal folly.

By carefully observing the following directions any one may quickly and accurately set a slide valve about which he has no previous information. Disregarding the position of the engine entirely, set the eccentric carefully on one of its dead centers. Then adjust the length of the eccentric rod (or valve stem) so that the valve will show one port wide open. If, on turning the eccentric to the other dead center, the valve shows the other port just wide open, then the length of the rod is right. If, however, the valve moves past wide open port, measure the distance from the end of the valve to the edge of the port, and mark half way. Then adjust the length of the rod so as to bring the valve to this mark, which will give the proper length. When the valve rod length is found, set the engine on the dead center and advance the eccentric ahead of the crank until the valve shows the required lead—usually about one one-hundredth of the cylinder diameter—then fasten the eccentric, and the job is done. Ten minutes should usually suffice for the whole job where the engine is of the ordinary slide valve type. The same principles explained here hold good for any valve motion of the slide type, whether rocking, piston, or single valve automatic.

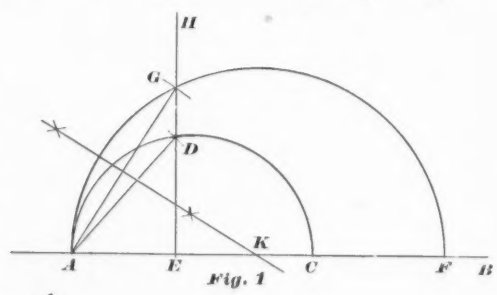


Fig. 1

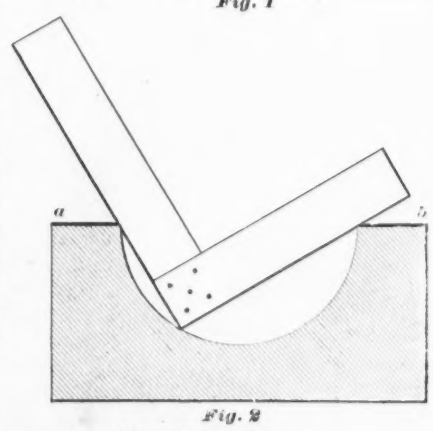


Fig. 2

SOME STRAY KINKS.

Modern Locomotive Construction.

BY J. G. A. MEYER.

SEVENTY-SECOND PAPER.

Stress Per Square Inch on the Main Rod Bolts.—In our last paper we have given the method for finding the shearing force to which the bolts in the main rod are subjected. Our next step will be to find the area necessary to resist this shearing force, and this area will be equal to the total cross-sectional area of all the bolts through one end of the rod. In order to find this area we must first establish the stress which should be allowed per square inch. For the sake of simplicity, we shall consider that these straps are subjected to a shearing stress only, and shall consider that the total stress is equal to the total pressure on the piston. Now, assuming, as we have done before, that the pressure in the cylinders on locomotives at present in service, whose safety valves are set to 130 pounds, will be 120 pounds per square inch, and then determining by calculation the stress (due to the pressure of 120 pounds) which has been allowed per square inch of cross-sectional area of the main rod bolts used in these engines, we find that this stress per square inch varies in different locomotives from 7,000 to 9,000 pounds, and in one case we found the stress to be as high as 12,000 pounds per square inch. Our experience leads us to believe that, when the best quality of iron is used, 8,000 pounds per square inch of the cross-sectional area of the main rod bolts will give good results and should be adopted. The best quality of wrought-iron of which these bolts are generally made possesses an ultimate shearing strength of about 56,000 pounds per square inch; if we now assume that these bolts are simply subjected to a shearing stress, and allow 8,000 pounds per square inch of section, we adopt 7 as a factor of safety. Hence, if the ultimate shearing strength of the iron is less than 56,000 pounds per square inch, say it is only 49,000 pounds, then the safe working stress to be allowed per square inch will be equal to

$$\frac{49{,}000}{7}=7{,}000 \text{ pounds.}$$

From the foregoing remarks we conclude that the total cross-sectional area of the bolts, that is, the area which has to resist the shearing force, must be proportioned so that the stress per square inch will be 8,000 pounds.

After this, when the number and diameters of the bolts are to be established, we may be compelled to change this stress of 8,000 pounds per square inch, because the general practice in locomotive building is to avoid $\frac{1}{64}$ and $\frac{1}{32}$ of an inch in the diameters of the bolts, and therefore, in establishing the nearest number, and adopting the nearest practical diameters to those for which the result of the calculations call for, the stress may be somewhat greater or less than 8,000 pounds per square inch; indeed, we may have to be satisfied as long as the stress falls within the limits of 7,500 to 8,500 per square inch for the best quality of iron. For an inferior quality of iron the stress should be less.

Now, having established the stress to be allowed per square inch, we can easily find the total cross-sectional area of the main rod bolts through one end of the rod by the following rule:

Rule 51.—Divide the total pressure on the main rod, as found by the diagram, Fig. 430, by 8,000; the quotient will be the total cross-sectional area of the main rod bolt through one of its ends.

Example 82.—The total pressure on the main rod given in Example 81 is 24,524.25 pounds; what will be the total cross-sectional area of the bolts?

$$\frac{24{,}524.25}{8{,}000} = 3{,}065 \text{ square inches.}$$

Diameter of Main Rod Bolts.—These bolts, as we have stated before, are tapered, hence, when we speak of the diameters of the bolts we mean their small diameters. In a large number of locomotives the rear strap is generally wider than the front or crosshead strap. Careful observation seems to indicate that the diameter of any one of these bolts should be equal to about one-third the width of the rear strap; in some engines the diameters are a little greater, and in others a little less than this proportion. We may therefore assume that it is good practice to make the diameter of the bolt (as near as possible as the avoidance of 64th or 32d of an inch in the diameter will allow), equal to one-third of the width of the rear strap. Hence we have the following rule:

Rule 52.—Divide the width of the rear strap in inches by 3, the quotient will be the diameter of the bolt.

Example 83.—The width of the strap is $2\frac{3}{4}$ inches; find the diameter of the bolts.

$$\frac{2.75}{3} = .916,$$

which is nearly equal to $\frac{59}{64}$ in. Avoiding 64th or 32d inches, we say the diameter of the bolts should be $1\frac{5}{8}$ inches. Some builders will make these bolts $\frac{7}{8}$ inch diameter.

Number of Bolts Through Each End of Main Rod.—When we know the diameters of the bolts, and also the total cross-sectional area which has to resist the shearing force, the number is easily determined by the following rule:

Rule 53.—Divide the total cross-sectional area of the bolts, as found by Rule 51, by twice the cross-sectional area of one bolt; the quotient will be the number of bolts required.

Example 84.—The total cross-sectional area of the bolts is 3.065 square inches, the diameters of the bolts $1\frac{5}{8}$ inches. How many bolts will be required? The cross-sectional area of a $1\frac{5}{8}$ bolt is equal to .69 inch; hence

$$\frac{3.065}{2\times.69} = 2.2; \text{ say 2 bolts.}$$

The stress per inch, when the taper of the bolt is taken into account, which, for the sake of simplicity, has been left out of consideration, will not exceed 8,500 pounds.

Example 85.—The total pressure on one main rod of a locomotive—cylinders 18×24—is 31,000 pounds, the width of the strap is $2\frac{3}{4}$ inches; find the diameters and number of bolts.

According to Rule 51, the total cross-sectional area of the bolts should be

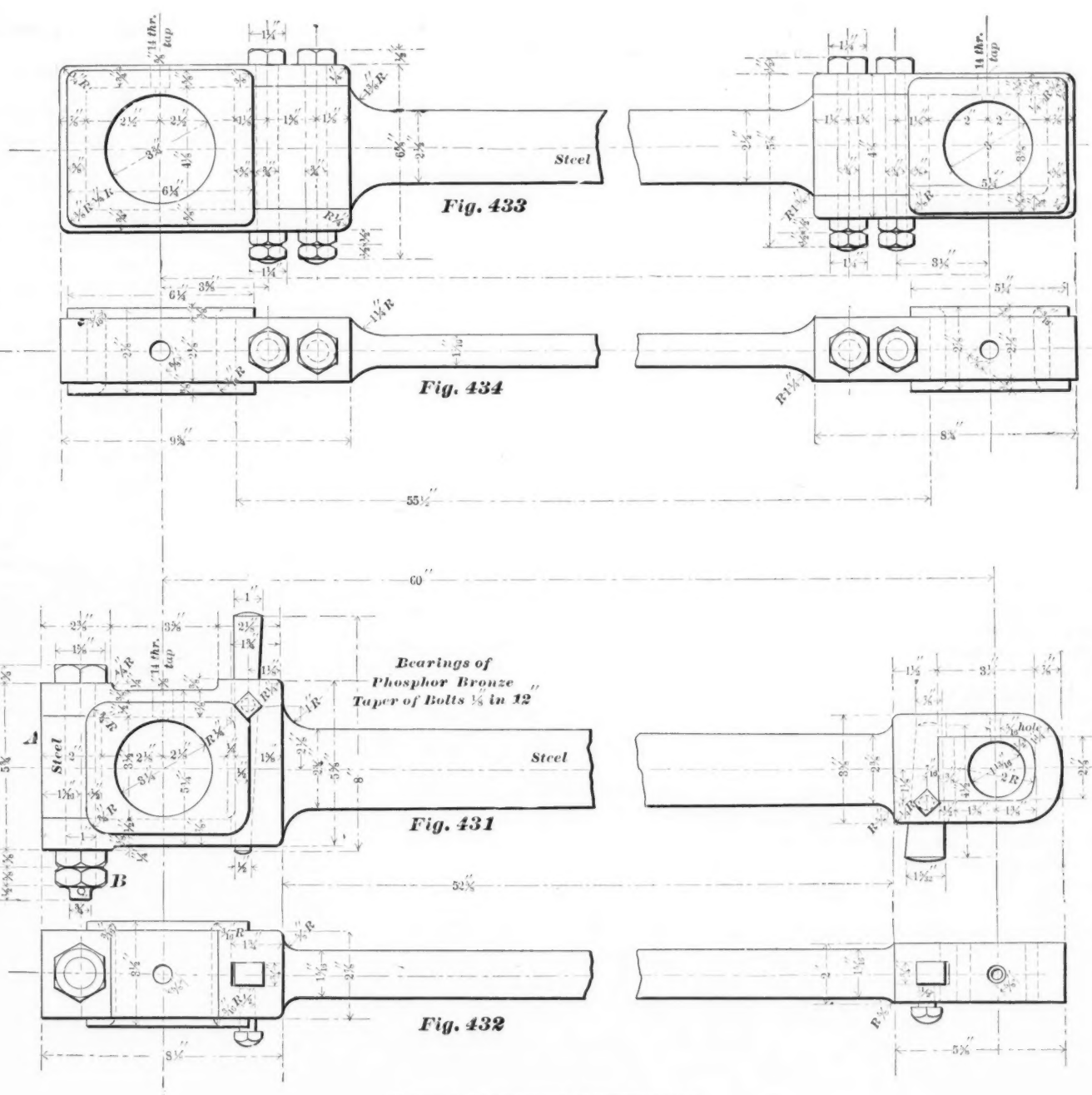
$$\frac{31000}{8000} = 3.87 \text{ sq. in.}$$

According to Rule 52, the diameter of each bolt should be

$$\frac{2.75}{3} = .916, \text{ say } 1\tfrac{5}{8} \text{ in.}$$

The cross-sectional area of a bolt $1\frac{5}{8}$ inch diameter is .69 square inch; hence, according to Rule 53, the number of bolts required will be

$$\frac{3.87}{2\times.69} = 2.8; \text{ say 3 bolts.}$$



MODERN LOCOMOTIVE CONSTRUCTION.

Some locomotive builders use three bolts $\frac{7}{8}$ inch in diameter for the same size of engine.

Example 86. The total pressure on one main rod of a locomotive—cylinders 20 × 24—is 38,000 pounds, strap 3 inches wide; find the diameters and number of bolts.

According to Rule 51, the total cross-sectional area of the bolts will be

$$\frac{38000}{8000} = 4.75.$$

According to Rule 52, the diameter of the bolts will be 1 inch. The cross-sectional area of a bolt 1 inch in diameter is .7854; hence, according to Rule 53, the number of bolts through each end of rod will be

$$\frac{4.75}{2\times.7854} = 3.$$

There are engines of the same size running with only 2 bolts 1 inch in diameter through each end. We believe that 3 bolts, 1 inch diameter, for a maximum steam pressure of 120 pounds in cylinders 20 inches diameter, will be safer and give better results.

Example 87.—What should be the diameter of the bolt shown in the rear end of the main rod, Figs. 431, 432? The cylinder is 12×16 inches; maximum steam pressure in the cylinder, 120 pounds; the distance through which the axle-box can move below the center line of motion of the piston is 2 inches.

Although the design of this rod is different from any we have previously shown, the foregoing rules are applicable. Here we will first have to find the total maximum pressure on the rod, as explained in the last paper, and illustrated in diagram, Fig. 340. The area of a piston 12 inches in diameter is 113.10 square inches, hence the total pressure on the piston is equal to

$$113.10 \times 120 = 13{,}572 \text{ pounds;}$$

consequently the line $a\ b$ in our diagram, Fig. 430, represents 13,572 pounds. But the length of the line $a\ b$ is not yet known, and must be found according to the instructions given in the 71st paper.

In order to suit the conditions given in the example, the length of the line $a\ c$ must be equal to 10 inches; that is, the sum of half the stroke (8 inches) and the distance (2 inches) through which the axle-box can move below the center line of motion of the piston. The length of the line $c\ b$ is equal to the length of the connecting-rod; that is, the distance between the centers of journals, and, as will be seen in Figs. 431, 432, this distance, or length of the connecting-rod, is 60 inches. Therefore the length of the line $a\ b$ will be equal to

$$\sqrt{60^2 - 10^2} = 59.16 \text{ inches.}$$

Consequently, according to last article, the line $c\ b$ will represent

$$\frac{60 \times 13572}{59.16} = 13764.7 \text{ pounds,}$$

which is the maximum pressure on the main rod.

The total cross-sectional area to resist shearing must be, according to Rule 51:

$$\frac{13764.7}{8000} = 1.72 \text{ square inches,}$$

and

$$\frac{1.72}{2} = .86 \text{ square inch,}$$

which will be the cross-sectional area of the bolt. The diameter of the bolt whose cross-sectional area is .86 square inch is nearly $1\frac{1}{16}$ inch, agreeing very closely with diameter of the bolt given in the illustration.

Figs. 431, 432 represent a main rod, and Figs. 433, 434 a side rod used on engines running on one of the elevated roads; the cylinders for these engines are 12 inches diameter and16 inches stroke. The rods are very good ones, and well adapted for these engines. The design of the main rod differs from the designs of rods previously given. Straps are not used; the rear end is an open one, which, after the bearings have been placed in position, is closed by the steel block *A*, firmly held in position by the bolt *B*. This bolt must be strong enough to resist the pull of the rod. The front end of the rod is designed to suit a class of crossheads with a single slide, such as is shown in Fig. 248.

The design of the side rod also differs from the designs of side rod previously given. Here the straps have been retained, but keys are not used.

The *Mechanical World* says:

Few steam fitters or engineers understand the valuable properties of graphite in making up joints; this valuable mineral cannot be over-estimated in this connection. Indestructible under all changes of temperature, a perfect lubricant, and an anti-incrustator, any joint can be made up perfectly tight with it, and can be taken apart years after as easy as put together. Rubber or metal gaskets, when previously smeared with it, will last almost any length of time, and will leave the surface perfectly clean and bright. Few engineers put to sea without a good supply of this valuable mineral, while it seems to be almost overlooked on shore.

A good deal is being said just at this time about increased speed on English railroads. When it is finally settled how fast this speed is there will be opportunity for comment. Just now it would appear that the speed on some English roads is materially greater than on any American roads.

The recent death of nearly twenty people in a building burned in New York city, in broad daylight, should call attention to defects in the law relating to fire-escapes. These are said to have been in accordance with the law, which does not speak well for the latter.

It is said that 72 flouring mills have been built in the Southern States during the first six months of this year.

"Boiler Studs."

By a blunder of the engraver, justice was not done to the drawings furnished by Mr. Landis for his article on "Boiler Studs" in our issue of Aug. 18. In the drawing from which Fig. 4 was engraved, Mr. Landis represented the chaser "*a*" as threaded its entire length, with the exception of a very short angle at the end. This, of course, is necessary to cut a taper thread. But the engraver took it upon himself to change the angle of the cutting face, and that cut off most of the threads. He also took the liberty of making the end of the stud, in Fig. 1, that screws into the shell, straight instead of taper.

Pressures in Moulds.

By S. Bolland.

THIRD PAPER.

The mould shown at Fig. 11 is almost the same as Fig. 10, the only difference being that the core (which is supposed to be one cubic foot) is surrounded by one inch thickness of iron. These altered conditions will bring out new ideas, and will aid materially in exploding some of the false notions which cling to this subject.

In the first place, it must be understood that the pressure under the core at *C* has reached its limit, immediately the molten iron begins to cover its upper surface at *E*, because as the iron flows over the core it acts as so much weight pressing downward, and by the time the runner is filled to the top of basin *A* the pressure downward is equal to the weight of a column of iron 12 inches square, and as high as the runner basin *A* resting on it. Such cores usually rest on studs *F G*, and are held in position by others *H I*; now, the actual pressure against the top studs will in this case be the weight of a cubic foot of iron, or 450 pounds, and the pressure against the cope will be equal to the weight of a column of iron 14 inches square, the height of *A B*, shown by broken lines *J K L M*. It is evident from this example, that, to hold such cores in position, it is only necessary to provide for an upward pressure equal to the weight of the amount of molten iron they displace; also that the depth at which they may be placed from the surface of the running basin is of no consequence, so far as the upward pressure is concerned; but the general pressure will be proportionate to the depth, as has been already explained.

The class of moulds which next claim our attention are the spherical, including balls, shells, kettles, pans, etc., and the cylindrical, including cylinders, pipes, columns, shafts, etc., cast horizontally. To thoroughly understand the method of finding the amount of upward pressure on this range of work, it is important that the examples given on average pressure be clearly understood.

What has been already stated with respect to average pressure is the principle, which, generalized, must lead to a rule that will answer for every variety and shape of mould. As before stated, the various parts of any surface, whatever be its form, will be subject to pressures, depending on their depths below the upper surface of the running basin; all points at the same depth suffering the same pressure. There is a certain pressure or mean of all the various pressures to which the points of the surface are subject, and whatever this pressure be, it must be such that, if diffused over the whole surface, the total amount of the pressure on that surface will not be altered. If, therefore, this medium pressure can be found, and the magnitude of the surface in contact with the liquid iron be known, the total pressure may immediately be obtained. To determine, therefore, the total pressure of any surface, "let the position of the center of gravity of that surface be determined by the rules established in mechanics, and let its depth below the highest point of the liquid iron be ascertained, then multiply the number of inches in this depth by the number of square inches of surface against which this pressure is exerted; the product will express the number of solid inches of iron whose weight is equal to the total pressure."

I have shown at Fig. 12 the section of a mould for a cylinder 12 inches diameter and 1 inch thick, cast horizontally. A careful examination of this drawing will at once reveal the method of finding the amount of upward pressure in all such moulds. The highest point is the upper surface of the running basin *A*, and it is from this point that all the depths are measured. To find the pressure under the core, we must first ascertain the point of average pressure, which is thus found: Let the square *C D E F* be drawn around the core, and from *C D E F* draw lines to the center; the point of intersection of these lines with the circle will be the point of average pressure. Lines drawn across the square at *B B* and *B' B'* give the rectangle *G H I J*, whose weight equals the amount of pressure under the core.

To find the cope pressure, draw *K L M N*; the intersection of *K N* with the outer

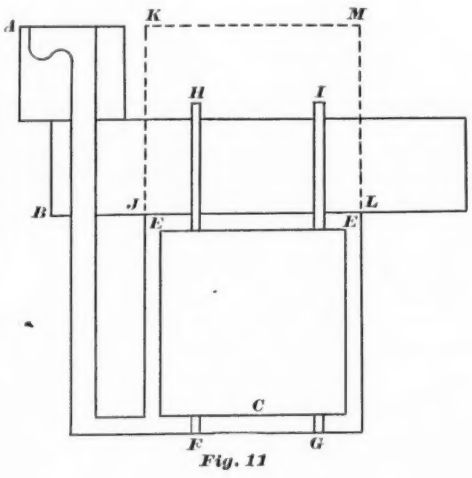


Fig. 11

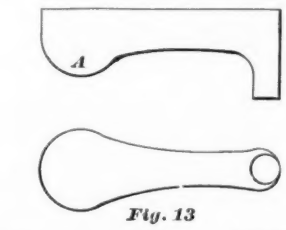


Fig. 13

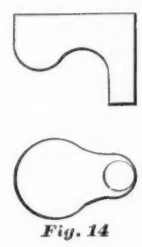


Fig. 14

Fig. 15

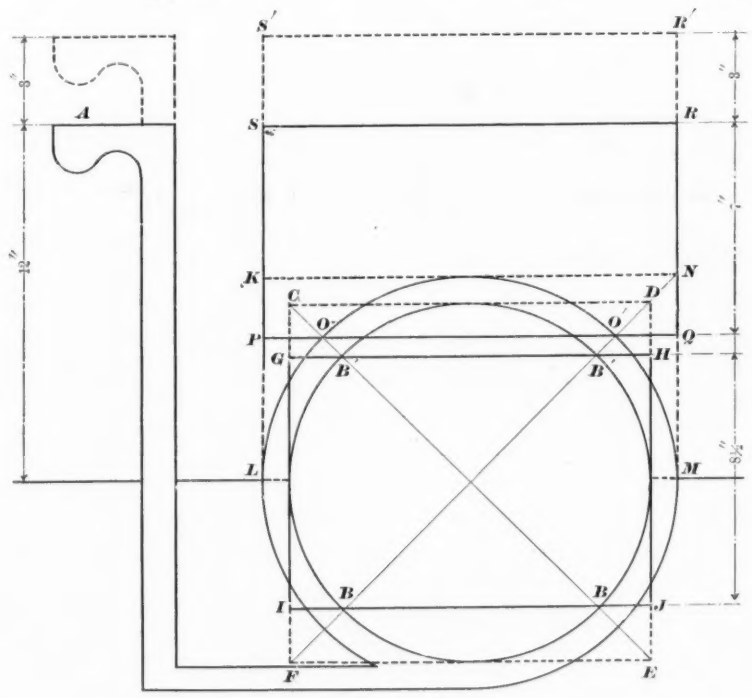


Fig. 12.

Pressure in Moulds.

FOR COPE.	
Width in inches	14
Depth "	7
Area in square inches	98
Length in inches	12
Total cubic inches	1176
Weight of a cubic inch	.26
	7056
	2352
Total pounds pressure per foot	305.76

diameter at *O* gives the point of average pressure for the cope. A line drawn across *O O'* the width of the outside of the cylinder at *P Q*, and then vertically to the height of running basin, gives the rectangle *P Q R S*, whose weight equals the amount of pressure under the cope. When these rectangles are obtained, they will in this case be found to measure 14 inches by 7 inches for the cope, and 12 inches by about 8½ inches for the core. Therefore the whole pressure per foot in length would be obtained, thus:

FOR CORE.	
Width in inches	12
Depth "	8.5
Area in square inches	102
Length in inches	12
Total cubic inches	1224
Weight of a cubic inch	.26
	7344
	2448
Total pounds pressure per foot	318.24
Add amount for cope	305.76
Total pressure cope and core per foot	624.00

The combined pressures per foot in length for a 12-inch cylinder, with the upper surface of the running basin 12 inches above the center of the mould, is thus found to be 624 pounds, and, of course, that amount of weight is needed to balance the pressure on every foot. In other words, if the mould is 10 feet long, the whole pressure would be 624 pounds multiplied by 10, equaling 6240 pounds.

An important feature of this question is that, should the depth from the center to the upper surface of the pouring basin be increased, the rectangle *P Q R S* must be brought up to its level by adding the increased depth to *R S*, as shown by the broken lines. The increase of pressure under the cope caused by these altered conditions would be just three-sevenths of the amount previously found, and a corresponding increase of weight would be needed to balance it. But these altered conditions do not affect the core, only in the general pressure all around it; for whilst additional depth creates more pressure, it must be remembered that this increase of pressure is exerted on the whole surface of the core, downwards as well as upwards; it must therefore remain stationary.

To put it otherwise, the amount of weight found to be necessary for holding down the core in this case is just what would be required if the mould was filled no higher than *G H*, for immediately the molten iron passes this point it begins to receive, in a downward direction, the same pressure as is produced on the cope upwards, which acts as added weight for increased pressure. Consequently it will be seen that the conditions laid down for securing the core are not affected by any increase in the depth after the points *G H* are passed.

The points of average pressure in spherical moulds are found by the same methods as shown for cylindrical moulds, by reason of which we can use Fig. 12 to demonstrate the principles involved; simply using the figures *G H I J* and *P Q R S* as elevations of cylinders, instead of as rectangles. Taking the figure as representing a sphere, the cope pressure would be equal to the weight of a column of iron 14 inches diameter, reaching from points *P Q* to the running basin *A*, as before explained. Now apply the same reasoning to the core (supposing the casting to be a shell), and we have the lift or upward pressure represented by the cylinder *G H I J*, or as equal to the weight of a column of iron 12 inches diameter and 8½ inches deep.

In the several figures used to illustrate this subject, it will be observed that the weight of cope or core has not been taken into consideration; but this may be done when it is practicable to ascertain the exact weight, and allowance made accordingly. But when the weights can only be approximated, good judgment will suggest a wide margin on the side of safety.

Another item for consideration, is the form of running basin used to pour the mould with. Figs. 13, 14, 15 will help to explain this part of the subject. It is very evident that if we pour a casting down a runner similar to the one shown at Fig. 15, that the molten iron will enter the mould with a greater impulse than would occur if the basin shown at Fig. 13 was used, because of the accelerated force of the fall being exerted immediately down the runner, whilst in the case of basin at Fig. 13 this force is spent at *A*, giving time for the molten iron to mass itself quietly before entering the mould. If runner 15 must be used (as in some instances it must) sufficient extra weight must be added to meet the necessity. Runner 14 meets this case half way, being a medium betwixt the two.

Being assured that pressure is proportionate to the depth, and that the depth is the height of the top of the running basin above the surface against which the pressure is exerted, numerous ways of reducing this pressure (and thereby saving labor in weighting) will suggest themselves, and may with safety be adopted. Risers, or flow-off gates, as large and as numerous as practicable, may be placed at convenient parts of the mould, and the iron allowed to flow off at a lower altitude than the running basin. Suppose the height of basin to be 24 inches from the surface of pressure, and the risers flow off at 12 inches high, or one-half; all else being favorable it would be correct to base the calculation on 18 inches instead of 24 inches deep (this being the average between the two), and by so doing save 25 per cent. of weight.

If the work in hand must have the whole pressure level with the top of running basin, make "assurance doubly sure" by adding some to the depth when making the calculation. Thus, if the actual depth be 12 inches, call it 13 inches deep. This will give one-twelfth more weight than is needed to balance the pressure, and will be found to be a sufficient proportion of allowance in all ordinary cases.

The following table will be found useful to such as have not the time or inclination to study the subject or pressure. It is only necessary to find the depth and area of lifting surface, and the weight required to balance the upward pressure will be found opposite these numbers. The accompanying examples will explain the use of the table.

TABLE SHOWING THE AMOUNT OF WEIGHT NEEDED TO BALANCE THE UPWARD PRESSURE OF MOLTEN IRON IN MOULDS AT GIVEN DEPTHS AND AREAS:

Depth.	Area.	Weight to Balance Pressure.	Depth.	Area.	Weight to Balance Pressure.
Ins.	Sq. Ins.	Lbs.	Ins.	Sq. Ins.	Lbs.
1	1	.26	6	60	93.6
1	2	.52	6	70	109.2
1	3	.78	6	80	124.8
1	4	1.04	6	90	140.4
1	5	1.3	6	100	156.
1	6	1.56	6	200	312.
1	7	1.82	6	300	468.
1	8	2.08	6	400	624.
1	9	2.34	6	500	780.
1	10	2.6	6	600	936.
1	20	5.2	6	700	1092.
1	30	7.8	6	800	1248.
1	40	10.4	6	900	1404.
1	50	13.	6	1000	1560.
1	60	15.6	9	1	2.34
1	70	18.2	9	2	4.68
1	80	20.8	9	3	7.02
1	90	23.4	9	4	9.36
1	100	26.	9	5	11.7
1	200	52.	9	6	14.04
1	300	78.	9	7	16.38
1	400	104.	9	8	18.72
1	500	130.	9	9	21.06
1	600	156.	9	10	23.4
1	700	182.	9	20	46.8
1	800	208.	9	30	70.2
1	900	234.	9	40	93.6
1	1000	260.	9	50	117.
3	1	.78	9	60	140.4
3	2	1.56	9	70	163.8
3	3	2.34	9	80	187.2
3	4	3.12	9	90	210.6
3	5	3.9	9	100	234.
3	6	4.68	9	200	468.
3	7	5.46	9	300	702.
3	8	6.24	9	400	936.
3	9	7.02	9	500	1170.
3	10	7.8	9	600	1404.
3	20	15.6	9	700	1638.
3	30	23.4	9	800	1872.
3	40	31.2	9	900	2106.
3	50	39.	9	1000	2340.
3	60	46.8	12	1	3.12
3	70	54.6	12	2	6.24
3	80	62.4	12	3	9.36
3	90	70.2	12	4	12.48
3	100	78.	12	5	15.6
3	200	156.	12	6	18.72
3	300	234.	12	7	21.84
3	400	312.	12	8	24.96
3	500	390.	12	9	28.08
3	600	468.	12	10	31.2
3	700	546.	12	20	62.4
3	800	624.	12	30	93.6
3	900	702.	12	40	124.8
3	1000	780.	12	50	156.
6	1	1.56	12	60	187.2
6	2	3.12	12	70	218.4
6	3	4.68	12	80	249.6
6	4	6.24	12	90	280.8
6	5	7.8	12	100	312.
6	6	9.36	12	200	624.
6	7	10.92	12	300	936.
6	8	12.48	12	400	1248.
6	9	14.04	12	500	1560.
6	10	15.6	12	600	1872.
6	20	31.2	12	700	2184.
6	30	46.8	12	800	2496.
6	40	62.4	12	900	2808.
6	50	78.	12	1000	3120.

NOTE.—These weights are exclusive of cope, core, covering plate, or whatever the pressure is exerted against.

EXAMPLE 1ST.

It is required to find the amount of lift or pressure under a flask, containing a plate 6 feet long and 4 feet wide. Depth from top surface of running basin to the surface against which the pressure is exerted, 12 inches, gates and risers adding 6 inches to the width of the plate.

OPERATION.

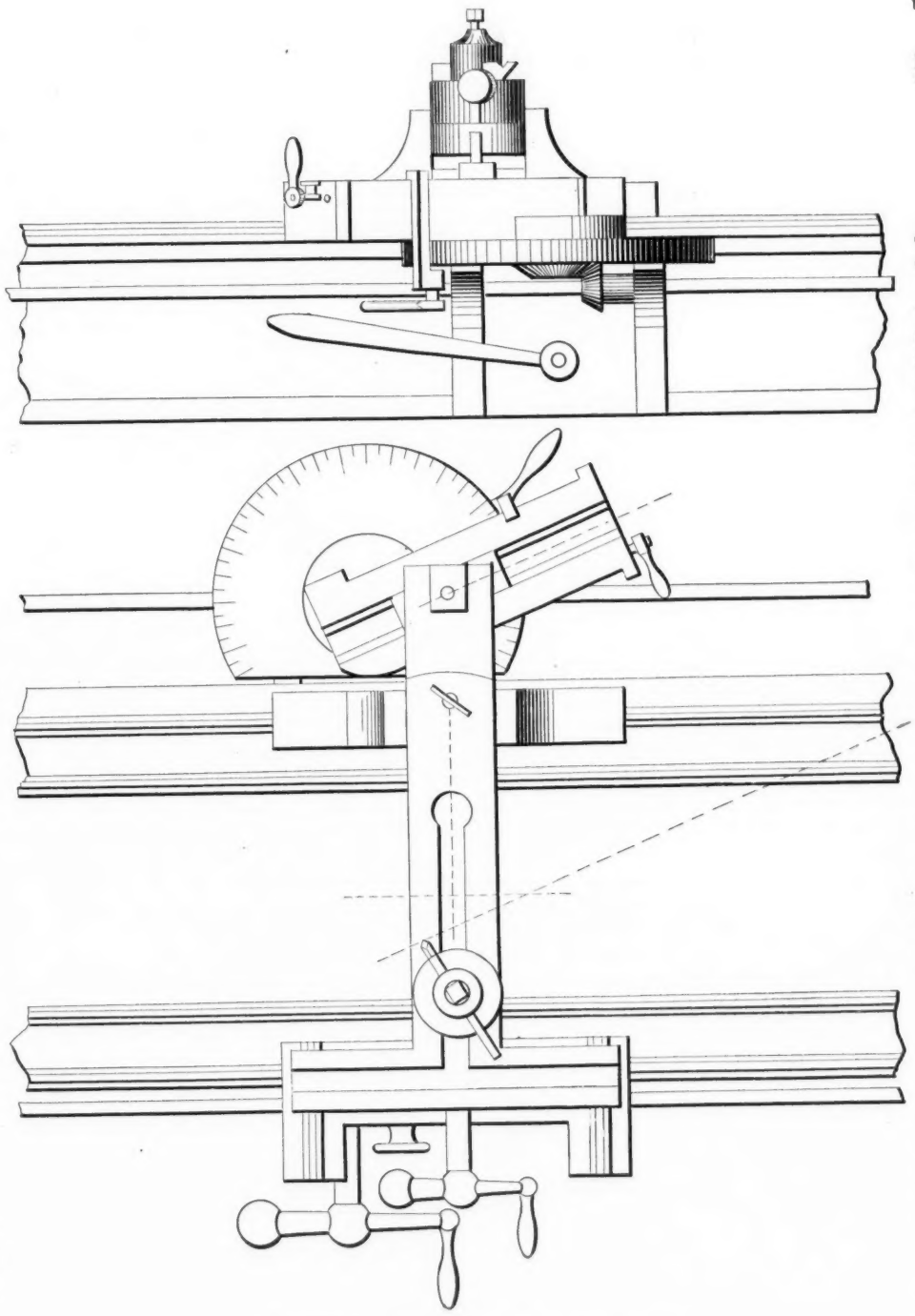
Length of plate in inches.....			72
Width of plate in inches, including gates.....			54
			288
			360
Total square inches of lifting surface.....			3888
Per table for 12 inches deep...	1000 ins.	=	3120 lbs
	3		3
	3000	=	9360
Per table for 12 inches deep...	800	=	2496
Per table for 12 inches deep...	80	=	249.6
Per table for 12 inches deep...	8	=	24.96
Per table for 12 inches deep..	3888		12130.56

Making 12130½ pounds, or a little over six tons, needed to balance the pressure. Suppose the cope to weigh 2,000 pounds; this would give a sufficient overplus; and this proportion of overplus must, in all cases, be allowed, especially in the event of having to run up to the full head of pressure.

EXAMPLE 2D.

Required, the amount of weight to balance the pressure against a surface containing 1651 square inches; depth from the top of running basin to lifting surface, 1 foot 9 inches.

	Ins.		Lbs.
Per table for 12″ deep.	1000	=	3120
" " "	600	=	1872
" " "	50	=	156
" " "	1	=	3.12
" " "	1651	=	5151.12



UNIVERSAL FEED ATTACHMENT FOR LATHES.

	Ins.		Lbs.
Per table for 9″ deep..	1000	=	2340
" " "	600	=	1404
" " "	50	=	117
" " "	1	=	2.34
" " "	1651	=	3863.34
Add amt. for 12″ deep.			5151.12
Totat weight needed to balance pressure....			9014.46

or a little over 4½ tons.

Note.—If risers of at least five times the capacity of the runners are set to flow off at four inches below the top of the running basin, the extra weight may be dispensed with, and the cope allowed as weight in the calculation.

In most cases, however, close figuring may be dispensed with by substituting another area or depth for the one in question.

For instance: "Suppose the pressure to be required for 975 square inches area, 6 inches deep," 1000 may be substituted for 975, and the answer obtained at once. The error, being on the side of safety, can be readily allowed.

Or it might be required to find the pressure at 9 inches deep for 1200 area. Then, 600 gives 1404, or one-half of the sum required.

Universal Feed Attachment for Lathes.

The engravings presented herewith show a taper attachment for use on lathes, invented by Mr. E. A. Alpress, of New Britain, Conn. It has some points of similarity to the Slate attachment, but differs from it in being so arranged as to apply the power for feeding in line with the bar of the attachment, and consequently in a line parallel to the travel of the tool. The attachment is intended to be fastened by brackets to the back of the bed, so as to admit of being moved along and clamped in any desired position, in the usual manner.

A splined shaft, or feed-rod, passes along under it, and by means of bevel gears, or worm and worm-wheel in connection with a short vertical stud located at the center about which the bar swings, imparts motion to the sliding block. It will be seen that by this construction there is no limit to the angle at which the attachment will work, and that, if the bar be placed in line with the bed of the lathe, it will produce the regular feed motion to the carriage without moving the cross-slide; while if it be swung around so as to stand at right angles to the bed, it will be in effect an automatic cross-feed, and will produce no motion of the carriage on the ways. Any intermediate position between these two extremes will of course produce motion in both the carriage and the cross-slide, and the corresponding angular motion of the tool will be secured. Thus the plate upon which the bar turns, and to which it may be clamped in the manner shown, can be provided with two sets of graduation, one indicating the angle to which the bar is set, and the other the taper per foot.

The short handle seen at the end of the bar is on the end of a screw which passes through the bar, and serves as a rack, into which a pinion, which is on the upper end of the vertical stud before referred to, works. The threads on one side of this screw are cut away, so that, when it is turned half way round, the pinion is disengaged and the tool can be moved by hand. The foregoing description, together with the engravings, will make the arrangement clear to those interested.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

BY W. H. HOFFMAN.

In this paper I will consider the design and construction of the steam cylinders.

Marine engineers who are familiar with the many designs of the modern marine engine are also familiar with the rules generally used in arriving at the proper thickness of the body and flanges of steam engine cylinders. These rules generally furnish us with the dimensions of the portions of the cylinders named, where these cylinders are constructed without reinforcing bands, or circular strengthening ribs, that encircle the cylinder body proper.

The triple and quadruple expansion marine engines of recent construction call for very high boiler pressures. Several new steamships are carrying 170 pounds gauge pressure, and in these cases, the initial steam cylinders are from 36″ to 42″ in diameter. With the old two-cylinder compound system, carrying a gauge pressure of 85 pounds, the high pressure cylinder was calculated as to thickness, to resist a working tensile strain of about 2,000 pounds per square inch of section, though some were subjected to 1,200 pounds only. The thickness of such cylinders varied according to the ideas of the builders, and were from 1⅛″ to 1½″ thick. Of course 1″ in thickness was ample to withstand the steam pressure, but there were other points that needed consideration, such as re-boring, handling, water shocks from "priming," etc., hence the extra thickness.

Practically no plain-bodied steam cylinder (that is, without circular ribs,) above 14″ in diameter, should be less than 1″ thick, and none of this type between 14″ and 20″ in diameter need be more than 1⅛″ thick, as this will allow for re-boring twice at least. The 42″ cylinders now in actual use on modern triple expansion engines, where the initial steam pressure is 170 pounds above the atmosphere, are usually from 1⅜″ to 1⅝″ thick, and are, when jacketed, in most cases in the form of linings, so that the space beween the lining and the main casting is filled with live steam from the boiler, thus forming a jacketed cylinder.

Some builders cast the jacket onto a common form cylinder body, and provide for expansion by casting corrugations on the outside portions of the jackets, but in either case the thickness of the barrel is the same.

It will be seen, therefore, that for the highest steam pressures, initial steam cylinders up to 50″ diameter need not be more than 2″ thick, and if there is no jacket, the reinforcing ring or rib can be introduced. With these ribs or rings a 50″ cylinder, using steam at 170 pounds gauge pressure, will be sufficiently strong if it is 1½″ thick, provided

there are, say, three reinforcing ribs 1½" thick, and 2½" deep, cast on the body of the cylinder. A cylinder of this kind could be re-bored until this thickness is reduced to 1¼", and would then be strong enough for its work. One great trouble with all *large* steam cylinders is the warping, or drawing, and a general distortion of the walls of the cylinder, when heated, this action being very prominent in those cylinders having large steam and exhaust chest, and passages cast on them. This custom (once almost abandoned) has recently been revived, owing to the use of the balanced piston valve, in the place of the balanced slide valve. This practice is now so common in the modern marine engine designs, that some engineers have adopted the plan of making the cylinders *very* thick, in order to partly prevent this warping of the cylinder proper.

Such designs are entirely unnecessary, however, as the circular ribs will answer all the purposes of the extra thickness, and are far better when other points are considered.

As to the strength of the average steam cylinder, the writer has usually found that the greatest number of fractures appear to have been caused by longitudinal strains and blows (in line with the bore) received during periods of excessive priming of the boilers, and racing of the engines. To prevent in a great measure this liability of fracture, I have had cast on the upper and lower flanges of the cylinder, two or three large lugs (as convenience would permit), and have passed through these lugs, from end to end of cylinder, large soft steel bolts, having a cross-section exposing a factor of ten, against the steam pressure. These bolts are brought to a uniform stress, while the cylinder is at its average temperature, and at such temperature a compressive strain is brought to bear on the body of the cylinder, which is fully equal to the elastic extension of the cylinder casting while under the initial steam pressure. Under these conditions, when any undue strains or shocks occur, the force of these strains is immediately transmitted to these tension bolts, which, being of superior tensile strength, relieve the body of the cylinder of at least one-half of the shock. No detail can be too safe in the construction of steam machinery for the marine service.

There are several methods of calculating the proper thickness of cylinder flanges, though but few of them mention the distance from the body of the cylinder to the center of the cylinder head bolts, in their basis of calculation. If a sharp corner occurs in the design, where the flanges join the body of the cylinder, it is an element of weakness, as the metal, when cooling, after casting, tends to separate at the angular line of this junction, and a casual examination of the cross-section at this point will disclose the fact that the fusion between the flange and the wall of the cylinder is very imperfect. A good round corner, say with a radius of ¼ of an inch, will produce quite a different result, and will increase the strength fully 30 per cent.

LETTERS FROM PRACTICAL MEN.

That Cutting Tool.

Editor American Machinist:

My comments on cutting tools are prompted only by a desire to see the best practice advocated in your columns.

By Frank H. Richards' sketch and words, August 11th, he acknowledges all I claimed July 28th, except that a circular groove is sometimes an advantage on soft stock. I now add, and especially in a screw machine.

The sketch of "Better Style," reproduced at Fig. 1, is very good. But it may be noticed that the point is so high above the line of stock that he has tipped it down (probably to reach the center of lathe work) thereby losing much of the advantage of the circular top. In grinding the front of this tool I think in practice he would be more likely to follow the dotted line.

Now suppose we try to use this tool in a planer to cut soft steel. On most planers the vertical feed is too rapid for this purpose, so we feed by hand, and uneven. One light feed and the tool may slip over; next feed a little stronger, which makes a heavy chip. This springs the planer head, and the tool dips in; result, fresh illustration of "survival of the fittest."

Fig. 2 illustrates a style of spring tool (well known, but I think not well enough known,) that can be used to advantage on a lathe as well as planer, and especially for irregular shapes. A wide tool of this style can be used on a light planer without chattering, when a straight one would stop it. How wide they can be used above 1½" I am unable to say. But they must be proportioned to suit the work. The cutting edge being back of the weakest point, it dips out instead of into the work. The curved face causes the chip to roll up, instead of welding in ahead of the tool. Much more can be said in favor of the spring tool. I will leave it for others. ANOTHER RICHARDS.

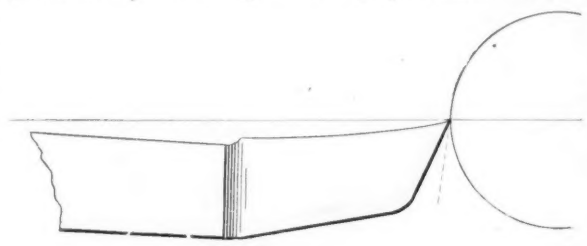


Fig. 1

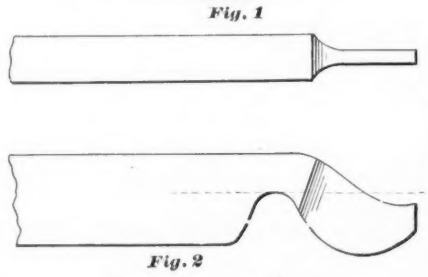


Fig. 2

THAT CUTTING TOOL.

Steamship City of New York.

The ocean twin screw steamship City of New York, the latest addition to the Inman line of steamers, completed her first trip across the Atlantic on Aug. 10. Although delayed on her voyage, it is claimed that she behaved splendidly at sea, rolled comparatively very little, and her engines worked about as well as any new machinery can be expected to work. The delay was caused by one of the circulating pumps getting out of order. It may be stated here, to the credit of the manufacturers of the Worthington pump, who have sixteen of their pumps on board of the ship, that it was not one of their pumps which caused the delay. This magnificent steamer was built by Messrs. James & George Thomson, of Clydebank, Scotland. In building this steamship, the problem that presented itself was to secure the nearest approach to absolute safety, the highest possible speed, and the greatest personal comfort. In order to secure safety, the steamer has a complete double bottom, so that the dangers caused by accidents from grounding will be reduced; the inside hull being still a protection. The space between has been made available for water ballast to lighten or deepen the draught when necessary. The hull is divided into fifteen separate watertight compartments. These divisions are made by solid bulkheads, rising from the keel to eighteen feet above the water line to the upper deck. These bulkheads are fixtures, without any doors or openings whatever, so that no door can be found unaccountably open and unworkable in times of danger. Should a collision occur, by which one or two, or three, or even four of these compartments (each about thirty-five feet long) are filled with water, it is claimed that the buoyancy of the ship would not be materially affected. Also, if a hundred feet of the bottom or the sides be torn away, the ship will still float. These solid bulkheads are also a preventive of the spread of fire, which they will confine to the compartment wherein it may originate, and where it can be speedily deluged with water.

The system of twin screws and duplicate steam engines enabled the builders to add further safety to the ship; as these engines are placed in separate compartments, with longitudinal bulkheads dividing them. These and other subdivisions through the bunkers increase the number of water-tight compartments to twenty-five. There are three different sets of boilers (each set having three) put well in towards the center of the vessel, in as many different compartments, and each having its own coal bunkers, containing ample supplies, and placed outside the boilers on either side of the ship, as an additional protection against collision.

The "Thomson & Bliss rudder" is used, which is described as a huge mass of enormous area, entirely under water, forming actually a part the ship's hull, and partaking of its shape to the fore point of the rudder, which is pivoted on the hull and inside of the ship below the water line.

The question of draught of water has received great attention in designing the vessel. The construction is upon a light draught, but, as it is necessary to have proper immersion for the screws, the lightness of draught required for crosssing the bar at all stages of tide will be obtained by using water ballast for subsequent immersion. This will be in the double bottom, previously referred to, fitted throughout the ship's length, giving a capacity for fifteen hundred tons of water ballast, and can be regulated at the will of the commander.

The principal dimensions of the ship are:

Length on load water line	525 feet.
Length over all	580 feet.
Breadth, extreme	63¼ feet.
Depth from top of upper deck cabins to bottom	59¼ feet.
Tonnage (gross)	10,500
Triple expansion engines:	
Diameter of cylinders, 45,71, and 113 in.	
Stroke	5 feet.
Horse-power, about	13,500

Twin screws are used for driving the ship. These are supported by massive steel trusses, incorporated into a structure taking the place of a stern post, and weighing twenty-six tons. It is claimed that this is the first adoption of double screws upon a transatlantic passenger steamer, although many war-ships have them. Each screw is driven by a separate triple expansion engine. The engines have piston valves; and nearly all the castings are of steel instead of iron, as is usual; the heaviest casting weighs fifty tons.

The Steel Company of Scotland and the Mossend Steel Company supplied, for building this steamer, some forty thousand separate pieces, weighing about seven thousand tons. These pieces were thoroughly tested, and have been carefully treated by special process to remove chances for corrosion. Their ductility has been proven by completely doubling, when cold, plates one inch thick, without any signs of fracture.

During her first trip across the Atlantic the engines were worked up to about 70 revolutions, and with that power she made an average speed of 18½ knots per hour. When the engines are worked up to the full guaranteed number of 85 revolutions, the speed will be materially increased, and it is expected that she will prove to be the fastest ocean steamer afloat. The highest day's record was 446 knots, recorded at noon on the 9th of August.

The passage from Roche's Point to Sandy Hook was made in 8 days, 11 hours and 29 minutes, corrected time. The actual time the vessel was steaming was 6 days and 21 hours. The ship's log shows the following runs in knots:

August	3—271	
	4—168	(Day the pump broke.)
	5—382	
	6—420	
	7—441	
	8—425	
	9—446	
	10—241	

For comfort, little, if anything, can be desired. The reduction of noise in working the ship adds to the comfort of the passengers. This is secured by having every auxiliary engine, excepting the air pump, whether used for handling cargo, moving coal or ashes, working the steering gear, the sails, or getting the anchor, or raising the stewards' lifts, worked by hydraulic power. These auxiliary machines number thirty-two, and include twelve hydraulic derricks and ten hydraulic hoists and lifts.

The highest, or promenade deck, extends, without break, over the entire length of the ship. A long central house contains the best passenger accommodations, about twenty-five rooms, arranged *en suite*, with bed-rooms, sitting and bath-rooms. The sitting-rooms are arranged with berths that are opened at night, as in a Pullman car.

The next deck beneath, that is, the upper deck, has upon each side, and completely sheltered by the deck above, a promenade about ten feet wide extending almost the entire length of the ship, and thus giving ample room for air and exercise. In the center space between these promenades is a house containing the chief public rooms. There are also on this deck about thirty fine state-rooms.

Beneath is the main passenger deck, and under it the lower passenger deck, where, in the different compartments, are the state-rooms for the first and second cabin passengers, each compartment having its own lavatories, baths and toilet-rooms. Arrangements are made to comfortably carry about 450 first cabin and 200 second cabin passengers.

The first cabin dining or grand saloon is located on the upper deck forward, and is a feature of this vessel. This saloon with alcoves covers the entire width of the ship, and rises above the promenade deck, surmounted by an arched roof of stained glass. On either side of this saloon alcoves extend to the side of the ship, with windows giving an outlook over the sea, making cosey nooks for private parties. Nearly three hundred persons can be accommodated in this dining-room.

Opening into the arched roof and overlooking the grand saloon is an oriel window, which forms the end of the drawing-room on the promenade deck. This spacious apartment gives accommodations for those who may not wish to venture outside. The library is also on the promenade deck. It is stocked with literature and writing materials. The smoking room is on the upper deck; in it can be accommodated nearly a hundred persons.

Every room is supplied with electric light. The ventilation is good. A pleasant impression is obtained by viewing the steamer from the shore. Her graceful lines, shapely clipper stem, pretty shear and well proportioned stern produce a pleasing appearance.

Another ship, the City of Paris, for the same line, constructed exactly like the City of New York, is now fast approaching completion, and is expected to be launched on Sept. 1st.

The Centennial Exposition at Cincinnati.

Some time since one of the New York papers referred to the Centennial Exposition of the Ohio Valley and Central States, as the "country fair now going on at Cincinnati," and there is probably a tendency among people who are at a considerable distance from it to underrate its magnitude and importance—a tendency which is probably augmented by the daily press of New York and other cities at a distance from Cincinnati, which, in accordance with the usual practice in such matters, belittles any such thing, if its own immediate neighborhood happens not to be directly interested in it. On the other hand, as might naturally be expected, the papers of Cincinnati exhibit some tendency to overrate the show, the "general result" being that no one gets a very accurate conception of it unless by an actual visit and inspection.

There is, as is always the case with such exhibitions, a good deal of space occupied by things which are of little interest, but the total available space is very large, and there is room for much which is without special interest, and which tends to give the show, in spots, the appearance of a country fair or fancy bazar, and yet have plenty of room to exhibit many things which are well worth seeing and which will be of great value in an educational way to the people who come to see them.

Most of the machinery on exhibition is made

in or near Cincinnati, manufacturers at a distance having probably under-estimated the importance of the exhibition, and thereby missed an opportunity of introducing their productions to a great many interested people whom they would have some difficulty in reaching in any other way. The exhibits of machinery will be spoken of in detail in a future article.

Some idea of the magnitude of the affair will be gathered from the statement that the total floor space is upwards of 513,000 square feet. The lighting of the buildings requires 3,000 incandescent electric lights and 420 arc lights, besides the 2,000 incandescent lights used for display purposes inside the buildings. In addition to this, thousands of lights, mostly gas, are used outside the buildings in illuminating the park in which the general exhibition building stands, and the streets for several squares in each direction, the whole forming at night a scene of rare brilliancy and attractiveness.

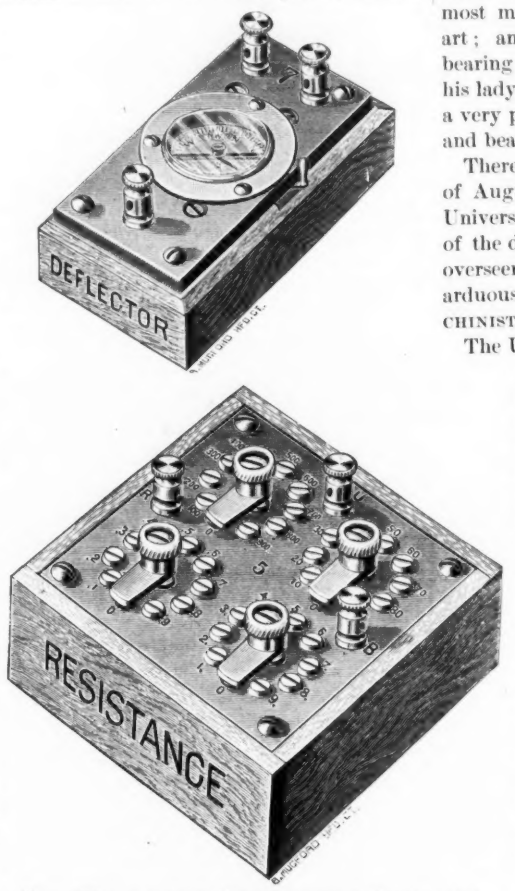
The principal electric light plant is situated at the north end of the park building, and contains the dynamos, engines and boilers. There are two Galloway boilers, by the Edgemoor Iron Company, rated at 150 horse-power each, and they are now putting in two others by the Tudor Boiler Company, of Cincinnati, the two being rated at 175 horse-power. There is a line shaft running through the center of the room, from which most of the dynamos are run, the shaft being of steel, 4" and 5" diameter and 100 feet long. It can be run all together as one shaft, or in two equal separate lengths, as may be desired; there being a friction clutch in the middle, by which the two parts may be connected or disconnected quickly at will. Each dynamo is driven through the medium of a friction clutch pulley on the line shaft instead of a plain pulley, so that any one of them can be stopped or started independent of the others, and without disturbing the belts or stopping the line. The clutches were furnished by the Falls Rivet Company, of Cuyahoga Falls, Ohio, and seem to be well adapted to the purpose.

There is an engine for each half of this line shaft, one built by the Atlas Engine Works, of Indianapolis, Ind., and the other by the Buckeye Engine Company, of Salem, Ohio; the former of 165 horse-power, the latter of 250.

Both these engines run under, and in fact that seems, for some reason, to be the predominating practice among the engines in use at the exhibition, and is not relished very well by the men who are in charge of them, and certainly gives to the engines a rather awkward appearance, as there are few mechanics who like to see an engine run in that way. Besides these there are two other engines which drive directly onto dynamos by means of belts, one being a Buckeye of 150 horse-power and the other built by Russell & Co., of Massilon, Ohio. All these engines are of the horizontal, automatic cut-off type, and are well-known engines.

The entire plant and its arrangement seem well planned and well adapted to its purpose. Three different systems of lighting are used—the Edison, the Mather and the Waterhouse. There are, in addition to these, some other engines and dynamos in use in other parts of the buildings, for display purposes and for furnishing small amounts of power to various exhibitors. In the Floral hall and in the center of the Park building are some very good examples of what can be done by combinations of projected and falling water, with incandescent electric lights enclosed in various colored glass. That in the Park building is a large fountain consisting of a central perpendicular jet surrounded by converging jets, the whole illuminated by the many colored lights in such a way as to make it resemble a section of an unusually brilliant rainbow. The display in the Floral hall is yet more beautiful, perhaps, and consists of an artificial cascade, surrounded by large rocks and plants, to give it an appearance of nature, and the water, as it comes down, falls over numerous ledges, under which, and in the water of the basin beneath, are placed the colored incandescent lights, the effect of the whole being a scene of indescribable beauty, and of especial interest as showing the possibilities of the incandescent light in this direction, on account of the readiness with which it can be maintained under water.

In the machinery hall and adjacent buildings there is in use about 2,600 feet of line shafting, one of the lines, that on the east side of Power hall, being 900 feet in length, which is said to be the longest continuous

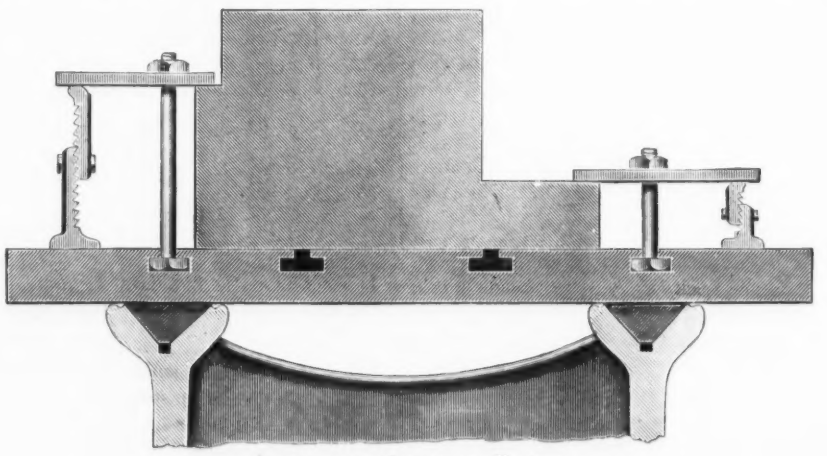


THE WATERHOUSE DIFFERENTIAL GALVANOMETER.

line of shafting ever run in this country. It is not regularly run all together as one line, however, but can be so run if occasion demands it, and was coupled together and run as one line, by one engine, during a stoppage of the other, caused by a mishap. The line on the west side of this hall is 700 feet in continuous length, and both lines are of steel turned $2\frac{15}{16}$" diameter.

In this department there are in use five engines: a compound condensing engine of the Corliss type, by the Lane & Bodley Co., of Cincinnati; one by the I. and E. Greenwald Co., of the same place, which is of the Brown type, and a Hamilton Corliss, being the largest, in addition to which there is a Rees high speed, and a Ball engine, all of which will be more particularly spoken of further on.

For running the textile fabric machinery



ADJUSTABLE CLAMPING BLOCKS.

there is 200 feet of line shafting run by a Vanduzen gas engine.

Machinery hall has been built over the canal, so that it runs through the center of the hall from end to end, the two sides of the hall being connected by an arched bridge in the center, and by raised floors at either end, accessible from both sides and used for serving refreshments such as Cincinnati is said to particularly delight in. On the canal are a number of genuine Venetian gondolas, brought over for use here, and for a small sum one can take a seat and a ride in a conveyance with which is associated much of the history of departed and almost forgotten generations of Venetians; but, instead of being surrounded by the historical buildings and passing under the famous bridge of Venice, as most of those who have sailed in such crafts have done, his way is lined on either side with examples of the latest and most modern specimens of the machinist's art; and, instead of meeting a gondola bearing a bold young Venetian carrying off his lady fair, he is much more liable to meet a very prosaic canal boat, drawn by a mule and bearing a burden of beer.

There was a race of gondolas the afternoon of August 11, and Mr. P. G. March, of the Universal Radial Drill Co., who was officer of the day, was, with his family, one of the overseers of the race, being assisted in the arduous undertaking by the AMERICAN MACHINIST man.

The United States Government has dealt very liberally with the exposition and the people who are interested in it, and the exhibits by the different departments of the Government will undoubtedly prove to be, to a majority of visitors, the most interesting feature of the exhibition. All the departments of the Government have contributed to make up this part of the show, the exhibits of the State, Interior, War, Navy, Treasury and Post-Office Departments being very interesting and valuable. The Patent Office, Smithsonian Institution, the Coast Survey and Geological Survey each contribute exhibits which cannot fail to be of great educational value to the people who will have an opportunity of seeing them.

Geo. M. Pullman, of palace car fame, is erecting himself a granite palace home on one of the Thousand Islands in the St. Lawrence. The money has generously been contributed by citizens of the United States in small sums, collected by porters.—*Lowell Journal.*

Remarkable Compound Engine Performance.

We have been favored with the following particulars of a preliminary test of tandem compound engines, built by the Hewes & Phillips Iron Works, Newark, N. J., for the Goodyear Metallic Rubber Shoe Company, of Naugatuck, Conn. The cylinders of these engines are $16\frac{1}{2}$ inch diameter of high pressure, and 32 inch diameter of low pressure, the stroke being 54 inches.

We have also been shown indicator diagrams from these engines, taken during the test. It is needless to say that these diagrams are very nearly perfect.

The results, as given by Mr. Barrus, are remarkable, particularly as the engines were underloaded. We shall make no comments upon this result at present, but hope to do so hereafter, with the records of tests of longer duration at hand. The cylinders of these engines were steam jacketed, as will be seen in the record.

THE HEWES & PHILLIPS IRON WORKS, NEWARK, N. J.:

Gentlemen: I enclose five sets of indicator diagrams taken from the Naugatuck engine, Nos. 2, 13 and 14, with jackets on. Below are the results of my computations:

1.	Duration	50. min.
2.	Total number of inches water used referred to one boiler	49.6 in.
3.	Weight of feed water used per hour	3746. lbs.
4.	Average I. H. P. developed	280.1 I.H.P
5.	Average M. E. P., H. P. cylinder	45.47 lbs.
6.	Average M. E. P., L. P. cylinder referred to H. P. cylinder	37.09 lbs.
7.	Average M. E. P., L. P. cylinder actual	9.83 lbs.
8.	Average boiler pressure	108. lbs.
9.	Average revolutions per minute	59. rev.
10.	Feed water per I. H. P. per hour	13.37 lbs.
11.	Water drained from jackets per hour	248. lbs.
12.	Steam accounted for, H. P. cylinder at cut-off	9.8 lbs.
13.	Steam accounted for, H. P. cylinder, release	10.78 lbs.
14.	Steam accounted for, L. P. cylinder at cut-off	10.48 lbs.
15.	Steam accounted for, L. P. cylinder at release	10.94 lbs.
16.	Proportion of feed water accounted for by indicator, H. P. cylinder at cut-off	.733 lbs.
17.	Proportion of H. P. cylinder at release	.806 lbs.
18.	Proportion of L. P. cylinder at cut-off	.784 lbs.
19.	Proportion of L. P. cylinder at release	.818 lbs.

Yours truly,

GEO. H. BARRUS.

The Waterhouse Differential Galvanometer.

This instrument differs from others in that the coils are not wound around the needle of the deflector, but are placed directly under it, thereby gaining an unobscured view of the face.

The needle swings over a German silver dial accurately graduated, and is jewel-mounted. The dial is polished, and as the needle can be seen and readings taken from any point, the mirror is dispensed with and an error of parallax prevented. The deflector has the usual two coils of wire connected to the binding posts shown in the cut. The coils are enclosed, nothing being exposed except the needle-case and binding posts, making an exceedingly neat and inexpensive form of galvanometer. For use in measuring resistance, a box of coils of the dial pattern is furnished, as shown in cut, marked "Resistance." At present they are made to measure a resistance from .1 of an ohm to 1,000 ohms, but can be made suitable for any special work.

For the benefit of those unfamiliar with the subject, the following is the use made of the instruments illustrated: We will suppose that it is wanted to know the amount of resistance in a conductor or coil of wire. A wire is connected from an ordinary battery cell to binding post *B* on resistance box. A wire is placed between binding post *R* on the resistance box and *R* on the deflector. A wire is then connected from one end of the conductor or coil to be measured to *U* on deflector, and the other end is connected to *U* on the resistance box. Another wire from the battery is used to touch binding post *B* on deflector. The contact hands on the resistance box are moved on points marked tenths of ohms, units, tens or hundreds, until, by touching the wire leading from the battery to binder *B* on deflector, the needle will not move. This will show that the unknown resistance in the conductor or coil being measured equals the readings on the resistance box.

The Waterhouse galvanometer is manufactured by the Waterhouse Electric and Manufacturing Co., Hartford, Conn.

Adjustable Clamping Blocks.

The engraving shows a pair of these blocks in use for holding work to a planer. They are designed for use anywhere that clamping blocks are required.

It will be noticed that these blocks are provided with teeth, by means of which they can be shortened or lengthened to suit varying conditions. Being firmly bolted together they will not yield to the pressure brought on them.

It would appear that these blocks would be very convenient for a variety of purposes around a machine shop, saving much time in hunting up blocks of the right length.

The manufacturers are the Energy Manufacturing Company, Philadelphia, Pa.

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Regarding Changes of Situations by Mechanics.

There is a quite prevalent idea that a mechanic who changes from one position or shop to another frequently necessarily has something in his constitution or make-up which renders him unfit to be depended upon; and there are many who utterly refuse to believe that such a man can be either a good mechanic, or possessed of any ability of whatever kind. It must be acknowledged that mechanics are often met with who seem to bear out this opinion; but, on the other hand, every one who has been associated with mechanics to any great extent must know plenty of them who have made many and frequent changes, in some cases extending through a number of years, and have finally found a place in which they were eminently successful, probably more so than they could by any possibility have become in any of their previous positions, if, indeed, their final success was not due, in a great measure, to the changes preceding it.

It is, of course, true that many and frequent changes by a workman are often caused by a fickle or discontented disposition, and often also by the fact that the person concerned has a much greater ability in obtaining situations than in keeping them after he has obtained them. But because some mechanics make frequent changes for such reasons, by no means justifies the universal condemnation of every one who is given to changing about.

It should always be remembered that there are many good reasons for making changes which are liable to present themselves to any mechanic at any time; and that it is as illogical and foolish for a mechanic to disregard or ignore such reasons simply from a general indisposition to change, or dread of leaving old associations and friends, as it is for any one else to decline to take a given course when good and sufficient reasons for so doing present themselves.

There are, of course, certain disadvantages which usually accompany a change of location, but it should not be forgotten that there are also certain advantages often to be gained by such changes, and that, other things being equal, the person most interested is best qualified to weigh, compare and decide which course to pursue; and that often there are reasons for changing which present themselves to him very forcibly, but which, from their nature, cannot be known or understood by others.

Most young men especially are benefited by moving about considerably. It is comparatively easy for a young man to adapt himself to new conditions and to take hold of work differing in its nature from that to which he has been accustomed, and the ability to do this, acquired during the period of life when it is easy to acquire it, is apt to be a decided advantage in more mature years.

Who has not seen men grown old in the service of some employer with whom they have learned their trade, perhaps, and have never worked elsewhere, and who are really in a pitiful situation of dependent helplessness? Being almost totally unacquainted with methods of doing work outside of the shop in which they have been trained, and not having acquired while young that facility for adapting themselves to new conditions which it is seldom possible to acquire during the years of mature life, they painfully feel their helplessness and dependence; and there are too many employers who do not hesitate to take advantage of it. Then, too, in judging of the conduct of employers in these matters it should be remembered that the same causes which have made the workman dependent upon him have also usually made the workman less valuable to the employer.

In almost every shop there are men to be met with who would probably be greatly benefited and developed by changing about a little, widening their horizon, and extending their acquaintance with other mechanics and their way of doing things.

The old proverb is true enough, "A rolling stone gathers no moss"; but it is well to consider that the gathering of moss may not be the only object of the existence of stones, and that, supposing it to be desirable that all stones should gather moss, there are many of them so situated as to make the gathering of it impossible, and not to be hoped for without some preliminary rolling about in order to secure more favorable conditions for moss gathering.

Manufacture in Maine.

Twenty years ago no one would have thought much activity in manufacture would ever be developed in the State of Maine. But the developments of the last few years are leading to a different conclusion. Several large manufacturing enterprises have been started in the State during that time, and this has made a demand for smaller enterprises, with prospects ahead for multiplication and enlargement.

Manufacture is being built up in Maine by the energy of the citizens—an energy very generally found in the inhabitants of a cold climate. This building up of industries is an example of what enterprise may do against apparent disadvantages; for it has always been considered that the climate of the State, alone, would prevent anything like extensive manufacture. In the end it may be found that the enterprise and industry born of such a climate more than offset the disadvantages. In such a climate workmen must be well housed, and well fed and clothed, but they can and do work harder than in a warm climate, and thus nature makes compensation. It is very doubtful if the disadvantages in one direction, of the extreme Northern States, are greater than the disadvantages, in the other direction, of the Southern States. And perhaps the advantages of both may, in their different ways, be found to balance the advantages accruing to locations more intermediately located in regard to climatic influence.

Of course there are lines of manufacture in which Maine cannot compete with those States more favorably located in regard to raw material and climate. But this is true of every locality. On the other hand, there are lines of manufacture in which that State possesses advantages. Then, again, there are other lines in which in this respect the advantages are fairly balanced, and push, enterprise and industry must decide the matter.

Maine may never come to be a great manufacturing State, but it is evident that the people there do not intend to go on buying manufactured goods without manufacturing something in the way of exchange. And in this they are wise. It is said that the manufactures of Maine already amount to more than eighty million dollars annually, which is a very creditable showing indeed.

A western engineer sends us a circular, issued by an Ohio inventor, in which he shows how he proposes to circumvent nature. He has invented a combination of racks and pinions, alleged cuts of which he publishes in the circular referred to, and by the use of which, as he tells it, he can, with two-thirds the power applied, do twice as much work in the same time as with the crank; or, applying it to turn a shaft, two small cylinders, with combined area of pistons equal to thirty-two inches, will do more work than can be done with a cylinder the area of whose piston is ninety-six inches, operating a crank. Having succeeded, as he apparently thinks, in beating nature, the inventor expresses himself as ready to sell rights to manufacture, or to sell the whole invention, which would be a very good thing to do.

After all, the Ohio inventor, upon whom our correspondent is rather severe, is not a crank. He is one of the men, the number of which grows satisfactorily less every year, who have succeeded—in their minds—in beating the crank by a good round majority.

Literary Notes.

We have received from Secretary Sinclair the report of the Proceedings of the Twenty-First Annual Convention of the American Railway Master Mechanics' Association, held at Alexandria Bay, June 19, 20 and 21, 1888.

The report is very complete, and it has been edited by Secretary Sinclair with great care and judgment. It is an important addition to the published proceedings of the association.

We have been favored with the prospectus of the University of Minnesota, College of Mechanic Arts and School of Practical Mechanics and Design, located at Minneapolis. This institution was established by the constitution of the State, and is endowed by the General Government. Regular courses of instruction are offered in science, literature, arts, civil, mechanical and electrical engineering, architecture, law, medicine and agriculture. With the exception of law and medicine, tuition is free. We should judge from the prospectus that the courses of instruction were quite complete and thorough. Field work, shop practice and testing seem to be well provided for. The shops seem to be well provided with tools and apparatus of modern construction. Regular degrees are conferred upon graduates. The School of Practical Mechanics and Design (a branch of the college) is designed for those who wish to fit them for positions of trust in shops and factories, or in the care of engines and boilers. This is in four divisions. There is a two years' course, in drawing, mathematics and shop work, and shorter courses in the management of boilers and engines, in shop work, drawing or wood carving.

Manual of Patent Law, for the use of inventors, is the title of a small book issued by R. G. DuBois, Washington, D. C. The book contains practical information useful to inventors, and is sent free upon application.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(397) O. C. F., Cornade Beach, Cal., asks: Can you give me the names of the best treatise on mechanical drawing; also gears and pattern making? *A.*—We believe the articles on Practical Drawing, now running in the AMERICAN MACHINIST, will give you the information required. For pattern making, the treatise on Modern Moulding and Pattern Making, by J. P. Mullin, or Pattern Making by a Foreman Pattern Maker, may suit your purpose. As for gearing, you will find the treatise on Tooth Gearing, by J. H. Cromwell; Kinematics, by C. W. MacCord; and the treatise on Tooth Gearing by George B. Grant, to be very useful books.

(398) "Planish," Wilmington, Del., asks: How is the smooth enamel or planish put upon the surface of iron forgings, such as small bolts 1 inch diameter and under? The skin or planish on some ⅝-bolts that I saw resembled the surface of Russian iron, and gave the articles a very fine and smooth appearance. I have also noticed the same finish on some horseshoes, and would like to know how it is done. *A.*—There may be a special process in use by some manufacturers for doing this; but such things are now forged by machinery, and it is done by keeping the dies in good order, avoiding too high heats, and sometimes by the use of a jet of water when forging. The appearance of such things is sometimes much improved, also, by putting them into a tumbling barrel with pieces of leather.

(399) C. E. B., Philadelphia, Pa., sends us a sketch of a mechanism consisting of two parallel screws which have at their lower ends worm wheels of 84 teeth, driven by right and left worms which are on the same shaft, this shaft being driven by a train of gearing and pulley, so proportioned that the worm shaft turns 6.3 revolutions, while the pulley turns one. The pulley is 18 inches diameter for 3½ belt, and the screws are ½ inch pitch. A platform is to be raised by the two screws, with a load on it of 500 pounds. He asks: 1. Would this be asking too much work of the pulley and belt? *A.*—We think it should do the work easily. 2. In using worms is it not better to place them as near the pulley as possible, or nearer to the weight? *A.*—That depends upon circumstances, but in such a case as shown in your sketch we think they are in the best possible place, *i. e.*, at the bottom of the screws.

(400) J. R. P., Cincinnati, O., writes: 1. Please let me know if Bessemer steel is made in this country, and how long ago is it since it was first made here? *A.*—The process was invented by Henry Bessemer, in Great Britain, and by William

Kelley, in the United States. Patents were issued to both by the U. S. Patent Office, and their interests were combined when the manufacture was established. Bessemer's patent dates from November, 1856, and Kelley's from January, 1857, the latter having been granted after a declaration of interference. 2. How are steel rails cut? Or, what I want to know is, whether the saws have teeth, or are they blanks? *A.*—We believe the general practice is to use saws with teeth.

(401) W. H. S., Norwich, Conn., asks: Will you please inform me what causes polished steel to assume the many different colors in raising it to a red heat? *A.*—It is caused by oxidation. 2. Is the beautiful mottled appearance of some of the parts of modern fire-arms produced by case-hardening in the usual manner with animal charcoal? *A.*—Not with charcoal alone, but with other things in connection with it, such as scraps of leather. It is also important to avoid exposing the articles to the air as much as possible before quenching them. 3. What is the cause of the different colors on case-hardened work? *A.*—It also is caused by oxidation. 4. Does a piece of case-hardened work which has a mottled appearance possess the same degree of hardness throughout? *A.*—No, it is hard upon the surface only, the depth to which the hardening penetrates depending upon the quality of the iron, the length of time it remains in the furnace, and upon the quality of the material used for packing.

(402) F. W. N., Adrian, Mich., writes: Do you think that I could drive a grain thresher with a hemp rope instead of a belt? We generally use a three ply 6-inch rubber belt, from 120 to 150 feet in length. These machines are mostly run with a 10 horse-power engine. My engine has a 3-feet driving pulley, the diameter of the pulley on the separator is 8 inches. The engine makes 250 revolutions per minute, and I cannot run it any faster. Would I require two ropes, or would one be sufficient. *A.*—The diameter of the pulley on the separator is too small for driving the machine with a hemp rope. According to an article by A. G. BROWN, AMERICAN MACHINIST, July 21, 1888, the diameter of the smallest pulley should be equal to 30 times the diameter of the rope. The distance between the shafts is generally made equal to 20 to 60 feet. With the present arrangement the speed of the rope will be 2,355 feet per minute. With this speed of rope and with pulleys of suitable diameter you would require a rope 1¼ inch diameter to transmit 10 horse-power. But since you will have to increase the diameters of the pulleys, the speed of the rope will also be increased, and consequently a smaller rope, probably 1 inch in diameter, may be sufficient to do your work. The rope must be kept dry; if wet, its working strength will be reduced to about one-quarter of its strength when dry.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

Link-Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link Belt Machinery Co., Chicago and N. Y.

See our new designed engine lathes in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed drill presses in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed shapers in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed brass working tools in Cincinnati Centennial Exposition. Lodge, Davis & Co.

2,000 feet of space in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See special adv't, page 16, Lodge, Davis & Co

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight-feed Lubricator: no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drawings, mach. patterns and models. Inventors' ideas perfected. Valentine, 15 Alling st., Newark, N.J.

Drop presses, punches and shears. Williams, White & Co., Moline, Ill., manufacturers.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W., Washington, D.C. Send for pamphlet and references.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago. Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Agents wanted for Name Stamps. The Hoggson & Pettis M'f'g Co., New Haven, Conn.

Special electric light for factories; large or small plants. Address The Waterhouse Electric and Mnnufacturing Co., Hartford, Conn.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 West 13th st., New York.

Patent Attorney. R. G. DuBois, 916 F st., Washington, D. C. Service at reasonable rates. Send for pamphlet containing list of references.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N.Y.City.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity; write for cuts and prices. Currier & Snyder, Worcester, Mass.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg Co., Hornellsville, N.Y.

A practical treatise on the steam engine, by Arthur Rigg, essays on the principles involved in design and construction of fixed engines; 312 pages, with 96 plates. 4to. cloth, $10.00. E. & F. N. Spon, 12 Cortlandt st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including August 11, 1888 issue, 56 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 70 articles have thus far appeared up to and including the August 4, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

J. A. Jarnett & Bro. will build a saw and planing mill at Sylva, N. C.

The Universal Horseshoe Company is building shops at Anniston, Ala.

Reynoldsville, Pa., is putting in water-works. Address all communications to Reynoldsville Water Works Company.

A water-power company are erecting a building at Wilton, Me., to be occupied by Robert Chase & Son as a peg factory.

It is said that there is invested in Michigan, in the lumber business, $40,000,000, in which business about 30,000 men are employed.

It is said that from 50 to 100 steam engines will be required in the great sugar refinery to be built by Claus Spreckles, in Philadelphia.

The Walter Heywood Chair Manufacturing Company, Fitchburg, Mass., has built an addition to the works, two stories high, 50 x 300 feet.

The city of Memphis, Tenn., is putting a up water tower 26 feet diameter and 160 feet high. Riter & Carly, of Pittsburgh, made the tower.

The H. Haller Manufacturing Company has been chartered at New Orleans, La., to manufacture hardware, copper, tin and sheet-iron ware, etc.

The Hartwood Switch Company has been organized, to manufacture railroad switches, frogs and other specialties, at Birmingham, Ala. J. T. Hart is secretary.

The Campbell Printing Press and Manufacturing Company, New York, have issued a large four-page circular, illustrating their two-revolution pony press. The press is well illustrated and described.

The Whittier Machine Company are constructing for the Piedmont Manufacturing Company, of Piedmont, S. C., six steel boilers, each 5½ feet in diameter, and one two-ton freight elevator.

Pedrick & Ayer, Philadelphia, Pa., have issued a large catalogue of special tools for railway repair shops. The catalogue is well illustrated and artistically printed. It is also completely indexed.

The Hargrave Manufacturing Company, Fall River, Mass., has ordered 10 boilers, 60 inches by 17 feet, for their new mills. The order was given to the Charles River Iron Works, Cambridgeport, Mass.

The Allentown Foundry and Machine Company, Allentown, Pa., have issued catalogues of the Wolf Improved Eureka turbine water wheels, which contain much matter of interest to users of water-power.

The Thomson-Houston International Company, Chicago, Ill., is sending to South America an incandescent lighting plant, to be placed in a mining establishment in the Andes, 14,700 feet above the sea level.

Eynon & Ingersoll, Cleveland, Ohio, inform us that they are receiving numerous orders for their Slab milling machine. This company has been obliged, by increase of orders, to build a new factory, which they will occupy early in the fall.

The Oakland (California) Iron Works have been incorporated, to manufacture machinery, milling supplies and foundry work of all kinds. The directors are George Cottrell, T. L. Armstrong, Edward Clark and others. The company has a capital stock of $50,000.

The American Waltham Watch Company, Waltham, Mass., have recently put in a 150 horse-power engine, and are arranging for four 500 light dynamos. The company is preparing to make their own fuel gas, which it is expected will materially reduce the fuel bill.

The Baxter (Electric) Motor Company, of Baltimore, Md., has put on double force, night and day, to keep up with orders. The company is building new shops, in which they expect to employ 1,400 hands. These shops, it is said, will be the largest in Baltimore.

Scottdale, Pa., is to have a new industry established in the near future, in the form of a works for a new method of coating metal, which promises to be a great success. The works are already in progress, of which R. W. P. Richardson, a well-known chemist and mining engineer, is the inventor and chief.

In the Pullman shops at Detroit over 700 men are employed, many of whom work overtime, in order to push the completion of a large number of new cars now in various stages of construction. The works are running to almost their full capacity, and have not been so rushed with new work for several years.

The old foundry property at Yaleville, N. Y., has been purchased by Orrin Martin, of Ogdensburg, from the National Bank estate of Malone, at a cost of eight hundred dollars. It is understood that Mr. Martin intends to thoroughly repair the property, which is in a very dilapidated condition and put it in a condition ready for business.

The Chicago & Atlantic Railroad Company have lately received some heavy mogul locomotives from the Brooks Locomotive Works, of Dunkirk, N. Y. and the engines have made such a good record in handling the heavy freight traffic of the road, that Mr. Selby, superintendent of motive power, recently contracted for five more engines of the same class.

Articles of incorporation have been filed by the Seattle and Southern Railroad Company, with a capital stock of $7,000,000. The object is to build a line from Seattle to Portland, a distance of 160 miles. At Portland the road will connect with the Oregon and California, which will make Seattle the virtual terminus of the Southern Pacific system. It is said that work will be begun very soon.

There is agitation for new water-works or the enlargement of existing works at Osbourne, Kan.; Fremont, Neb.; Manton, Mich.; Farmington, Maine; Allegheny, Pa.; Phœnix, R. I; East Wichita, Kan.; Ripon, Wis.; Gladwin, Mich.; Neodesha, Kan.; Hatfield, Kan.; Kissimmee, Fla.; Key West, Fla.; Jersey City, N. J.. Del Norte, Col.; San Diego, Cal.; Russellville, Ala.; Clifton Forge, Va.; Mason, Neb.

Messrs. Cooke & Co., of No. 22 Cortlandt street, New York, have secured the contract for putting an automatic engine in the United States Military Academy at West Point; they have also recently furnished a pair of automatic engines for the Central Trust Company, of New York City. Among their other recent engine orders are the Amalga Soap Company, Brooklyn; J. Pierpont Morgan, Cranstons, N. Y., and Hon. Levi P. Morton, of Rhinecliff, N. Y.

The Wichita (Kansas) Mining Company held a meeting recently in Wichita for the purpose of amending their charter and to increase the capital stock from $500,000 to $1,000,000. The company own and control upward of 36,000 acres of the richest coal-bearing land in the State, all within a radius of 100 miles from Wichita. The first drill has been started at Peabody; other drills will be started at once, and the richness of their landed estate shown up.

A Sharon (Pa.) dispatch says: A terrific explosion occurred at the Sharpsville furnace late last night, caused by the breaking out of the molten contents of a furnace. Great balls of red-hot iron were thrown higher than the stock house, which soon caught fire, but was extinguished before much damage was done. Two men were badly burned, the others escaping almost as if by miracle. A force of men went to work at once to repair the damage, which is heavy.

Hill, Clarke & Co., Boston, Mass., the well-known dealers in machine tools and machine shop supplies, have issued their 1888 catalogue. It is an artistically printed bound volume of more than 400 pages, excellently illustrated on tinted paper. The plan is followed of giving the names of the manufacturers of the tools illustrated in this catalogue, which appears to us to be a good one. The catalogue is fully indexed, and otherwise arranged very convenient for reference.

A press dispatch from Washington says: Prof. Elisha Gray, of Highland Park, Ill., has obtained letters patent, dated July 31, 1888, for a combination of instruments called the telautograph, consisting of a transmitter and a receiver, and designed for transmitting messages by wire between distant points by the sender in his own handwriting, thus doing away with skilled operators. The invention is based on the discovery of a new principle in controlling the electric current, whereby a pulsatory current is produced.

The *Industrial Journal* says there is more building going on now at Mechanic Falls, Me., than there has been for several years, and the industries of this live manufacturing village are in a thriving condition. The six paper mills, under the superintendence of C. R. Milliken, J. W. Penney & Son's machine shop and foundry, the corn factory, and J. A. Buckman & Co.'s clothing manufactory, are running to their full capacity. There is more doing at the shoe factory than usual, and the woolen goods manufactory of Harris & Rounds is working busily.

R. A. Belden & Co., New Haven, Conn., have issued the following: Our drop forgings and machine works, formerly located at Danbury, Conn., having been burned in the fire which occurred there on the 18th of June, 1888, we would respectfully inform you that we have purchased the large property in New Haven, Conn., known as the Mansfield Elastic Frog Shop, situated on the corner of Congress avenue and Dagget street, where, with a full line of new and improved machinery and largely increased facilities, we are prepared to execute all orders for drop forgings in iron, steel and copper; also Belden's improved crank planer and upright power hammer.

Gould & Eberhardt, Newark, N. J., are having a very good trade in their standard tools. They have recently furnished the Georgia State School of Technology with a drill press, a shaper and an automatic gear cutter; the University of Tennessee with a 24-inch planer, a drill press and an 18-inch emery tool grinder; Walter Scott & Co., of Plainfield, N. J., with their second 60-inch gear cutter, together with a large number of other tools; the Edison Machine Works, of Schenectady, N. Y., with a 36-inch gear cutter; the Daft Electric Company, of Marion, N. J, with a 36 inch gear cutter, a drill press and several winding lathes; Ribon & March, of Jersey City, with a 30-inch and a 36-inch drill press, and the Mexican Government shops with a shaper.

Following are among the recent sales of the M. C. Bullock Manufacturing Company, Chicago, Ill.: To the Negaunee Mining Company, Negaunee, Mich., one 6" x 8" exploring hoist; to the Jackson Iron Company, Negaunee, Mich., one 6"x8" exploring hoist; to T. H. Riley, Joliet, Ill., one 3" "Eclipse" rock drill outfit; to the Chicago and Lemont Stone Company, Lemont, Ill., one 5" "Eclipse" rock drill outfit; to the Deer Creek Coal Company, Glen Rock, Wyoming Territory, two 45 horse-power boilers; one pair 10" x 15" link motion engines, driving one pair of 66" x 60" drums; to the Atchison, Topeka & Santa Fe Railroad Company, Chicago, Ill., one 3" "Eclipse" rock drill outfit; to Nast Bros., Marblehead, Wis., one 3" "Eclipse" rock drill outfit; to the Detroit Mine, Ishpeming, Mich., one new underground diamond prospecting drill, "Beauty."

According to *The Daily Hot Blast*, the woodworking shop of the United States Rolling Stock Company, at Anniston, Ala., will be 1,000 feet long and 105 feet wide. The machine and blacksmith shop will be 105 x 825 feet, and other buildings in proportion. They will also build another foundry 80 x 160 feet, to be used in connection with their present foundry. "In carrying out the plans for the establishment of such a a mammoth enterprise as this, which, it should be remembered, will be the most extensive car works in the country, there are necessarily many unavoidable delays at the beginning, but the work already accomplished is surprisingly great, and the details for the buildings and machinery, requiring so much study and time, have been arranged, so that now everything is rapidly getting into shape for the final work of erecting these great buildings."

Regarding matters at Fall River, Mass., the *Providence Journal* says: With a very few exceptions the dividends of all the mills for the last quarter have been declared, and a glance at the list will explain why stockholders go about wreathed in smiles instead of with their pockets turned inside out, as has been the case during certain periods in the city's history. The past three months, like the three quarters preceding, show an unusually prosperous condition of things, and Fall River is to be congratulated on the fact that, in spite of the satisfactory showing made, the continued and large demand for print cloths, and the apparently short supply of the same, people with money to invest haven't lost their heads and plunged heavily, to use a turf expression. Although the factories have been coining money, and sales from week to week leave no stock on hand, but one new corporation has been started, and of the thirty-eight manufacturing establishments, only three have voted to increase their plant. Were the 120,000 odd spindles, which it is proposed to put in operation, running to day, the increased product would hardly affect the market, and as there are no indications of any further building, there seems to be no danger of overdoing the thing and so putting to death the time-worn hen of golden-egg capacities. It must be borne in mind that the dividends which have been announced for the quarter just closed by no means represent the actual earnings for that period, and simply serve to show the returns which it is possible to make with all the conditions favorable, while at the same time reserve funds have been laid by, varying according to the financial condition of the different corporations and the business judgment of those in charge.

Machinists' Supplies and Iron.

NEW YORK, Aug. 16, 1888.

Iron—American Pig—There is no change in prices, and the opinion generally prevails that there will be none for some weeks to come. The demand is far from brisk, although trade can hardly be characterized as dull. The feeling is that prices are not to go lower than at present, while hopes are entertained that there will be some improvement with the advent of cooler weather. We quote Standard Lehigh and North River brands, $17.50 to $18 for No. 1 X Foundry, $16.50 to $17 for No. 2, and $15 to $16 for Grey Forge.

Scotch Pig—We quote Coltness, $19.50 to $19.75; Glengarnock, $19.25 to $19.50; Gartsherrie, $19.75 to $20; Summerlee, $19.25 to $19.50; Eglinton, $17.50 to $17.75; Langloan, $19 to $19.50; Dalmellington, $18 to $18.25; and Clyde $19 to $19.50.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p. 11

Wanted—Position as draftsman. Address Box 15, AMERICAN MACHINIST.

Wanted—Good sheet metal die makers. Apply to Buhl Stamping Co., Detroit, Mich.

Young man, first-class machinist and fair draftsman, wants situation. E. J., AMERICAN MACHINIST.

Wanted—Situation as foreman or workman of a brass foundry, with a firm who runs one or two men; a man with family and strictly temperate; a practical workman on all kinds of metals; can give best of references. Address Box 11, AMERICAN MACHINIST.

A patentee desires to enlist capital to push an invention of acknowledged merit well known in the market to form a company to push the device; satisfactory references as to its merit, and standing of the advertiser, can be furnished. Address Box 16, AMERICAN MACHINIST.

Position wanted by practical man, age 40; design, drafting to finished mach. through all the departments; labor-saving mach'y a specialty; experience in engine, printing, shoe, sewing, tool and brick mach'y. Testimonials for entire management on application to F. Myers, Moore st., Winthrop, Mass.

Wanted—Situation by a man who has had thirty years' experience in machinery business as superintendent and salesman; is at present superintendent of machine shop; will be open for engagement after Sept. 15; references furnished if desired. Address W. E., Post Office Box 38, Hoosick Falls, N. Y.

Wanted—By an Ohio manufacturing concern, making heavy machinery and steam engines, employing forty to fifty machinists, a machine shop foreman, experienced in handling men and getting out first-class work at low cost; a permanent position open to the right man. Address, with salary desired, Box 12, AMERICAN MACHINIST.

Wanted—Foreman for boiler works, one who has had experience with marine and stationary work, also tank work; must read drawings, make estimates, lay out work and handle men and tools to full capacity; steady employment to proper party; only sober and industrious mechanics need apply; state references, age and experience. Address G. S. Wormer & Sons, Detroit, Mich.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner is king, and has no rival. Crescent Mfg. Co., Cleveland, Ohio.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

August C. Christensen, 24 State st., N. Y., mechanical engineer and draftsman; 25 years' experience.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

D. J. Kelsey, M. E., designs machinery and iron structures; pat. drawings. 31 Ins. Bld., New Haven, Ct.

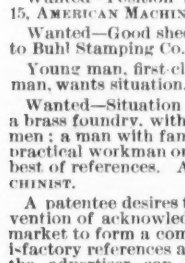
Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

For Sale—A, 20,000 lb. Stiles New Toggle Joint Drawing Press in first-class order. Apply Keystone Watch Case Co., 19th and Brown streets, Philadelphia, Pa.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

For sale or manufacture on royalty, flue welder; welds in fire any size or length; can be manufactured cheap; illustrated in *Locomotive Engineer* for July. Address John N. Buchanan, Batavia, N. Y.



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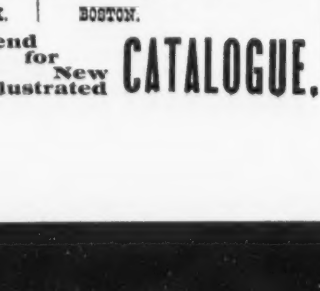

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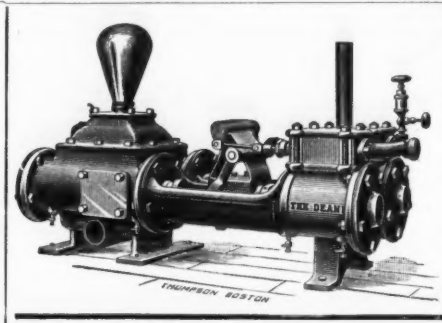

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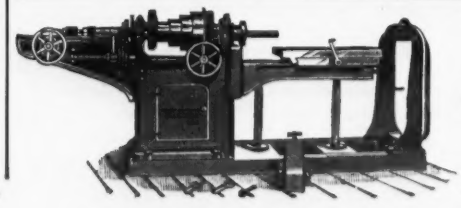

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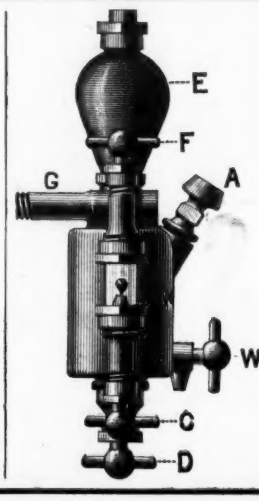

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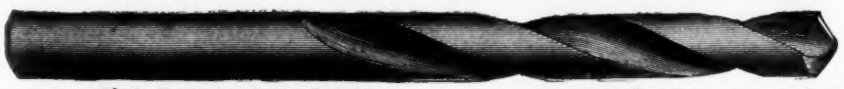

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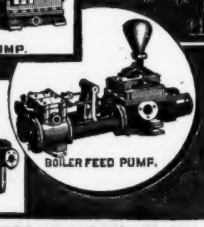

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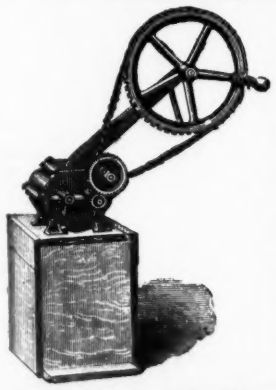

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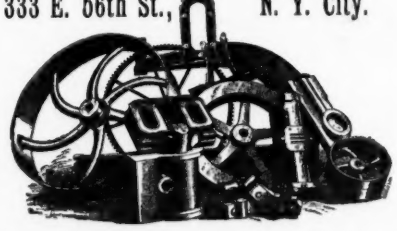

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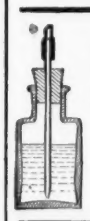

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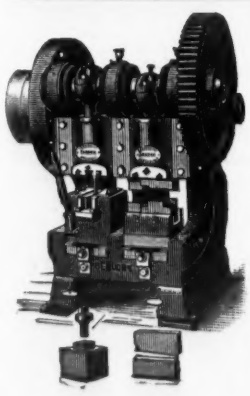

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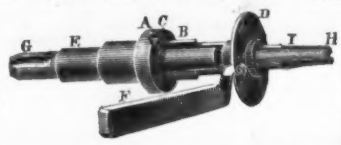

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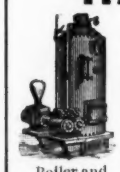

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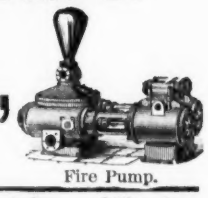

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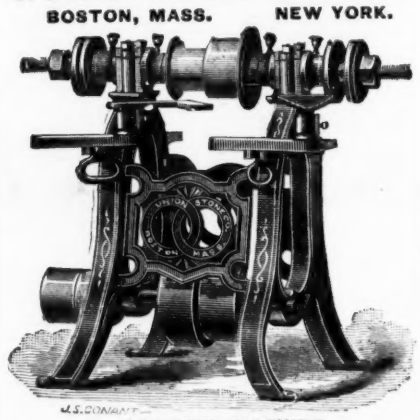

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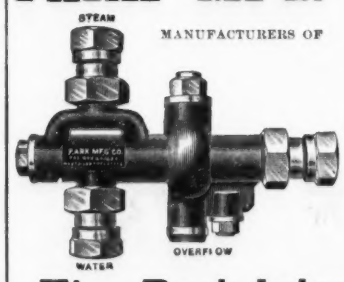

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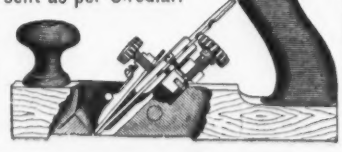

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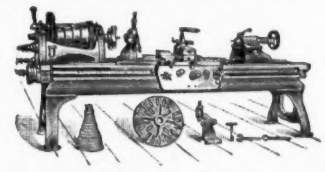

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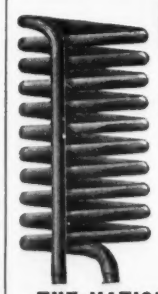

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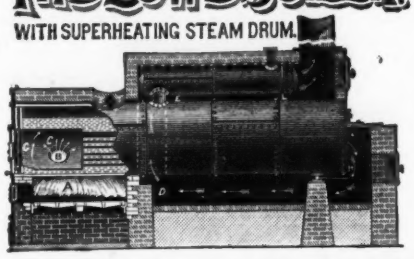

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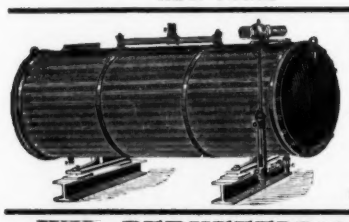

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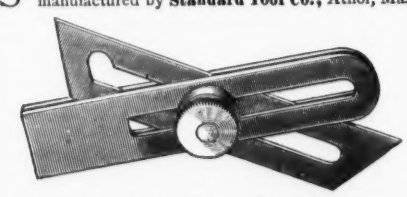

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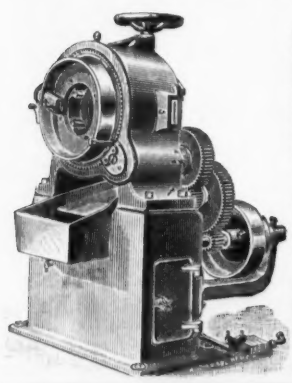

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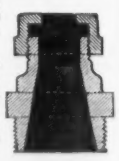

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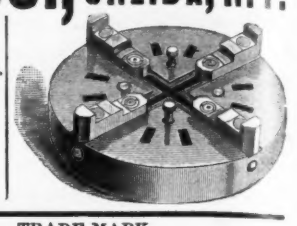

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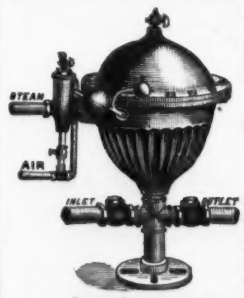

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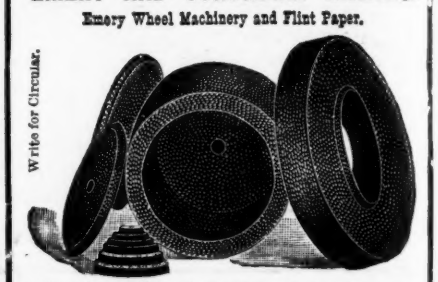

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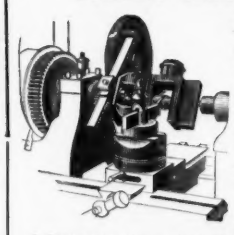

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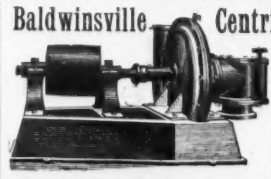

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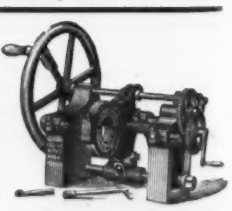

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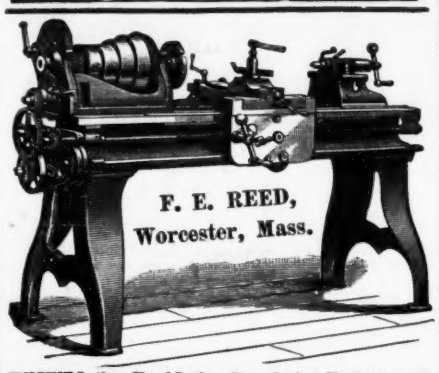

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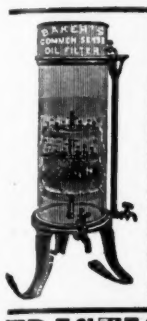

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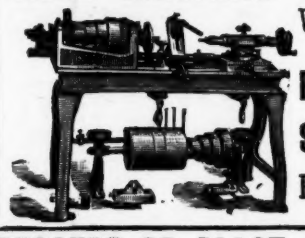

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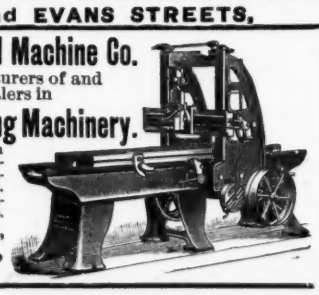

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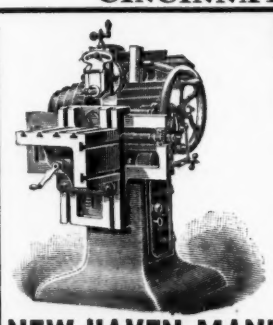

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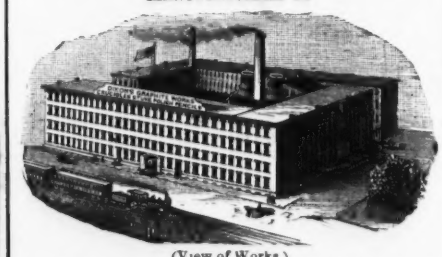

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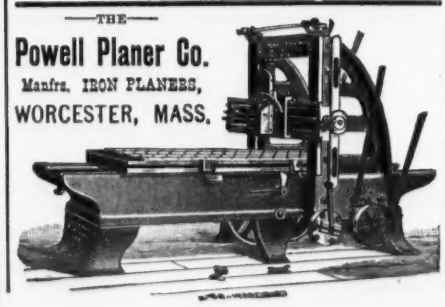

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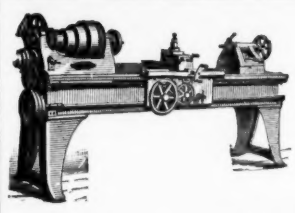

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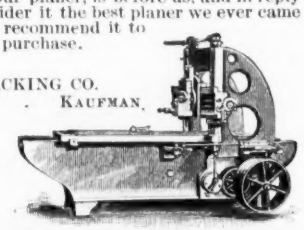

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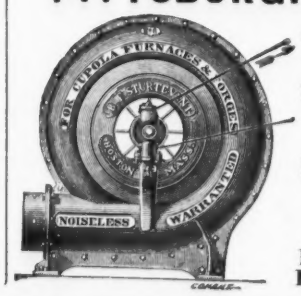

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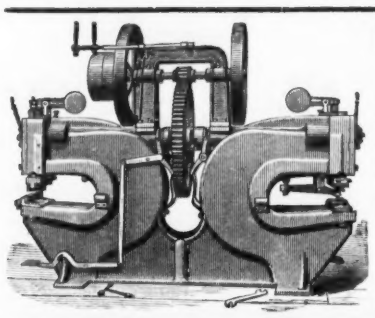

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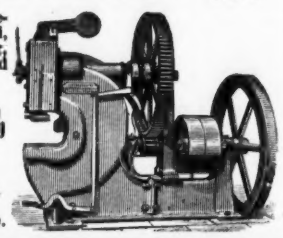

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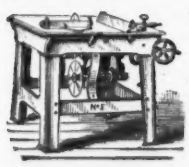

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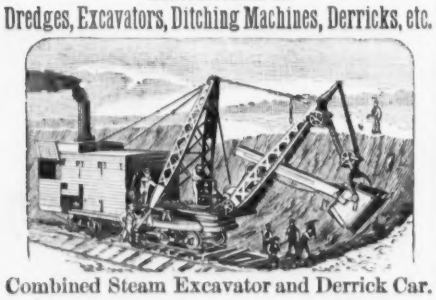

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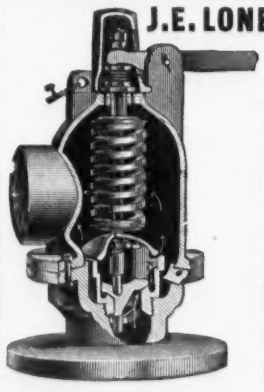

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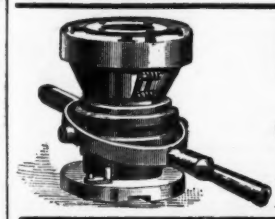

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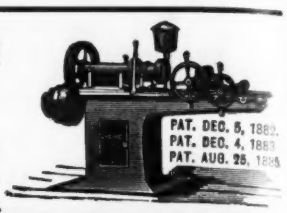

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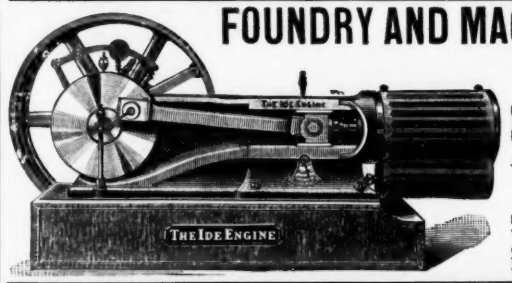

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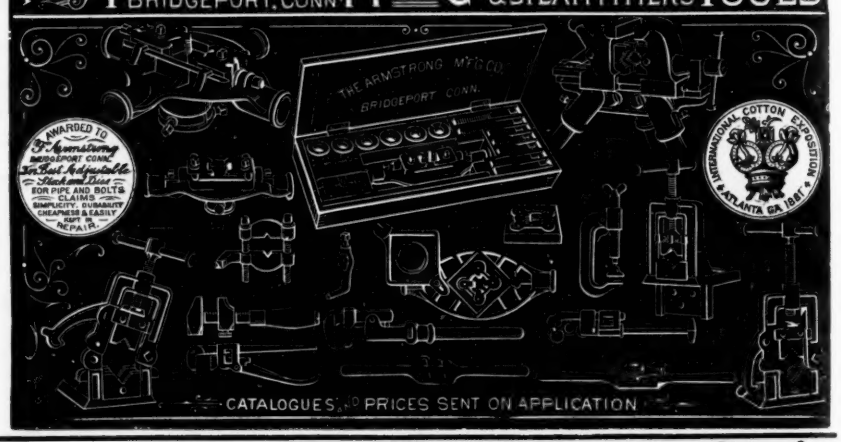

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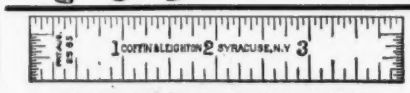

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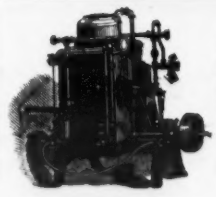

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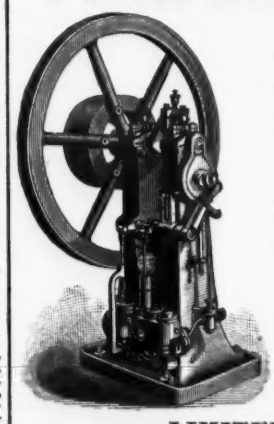

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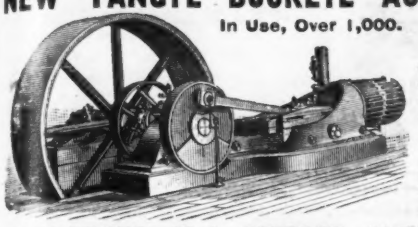

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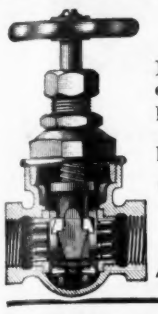

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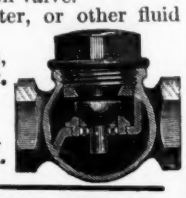

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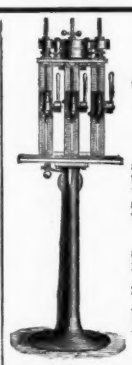

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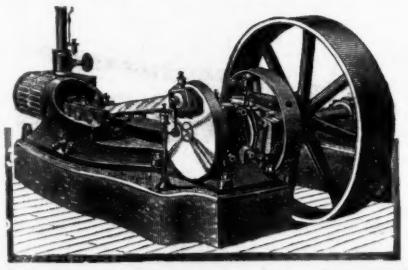

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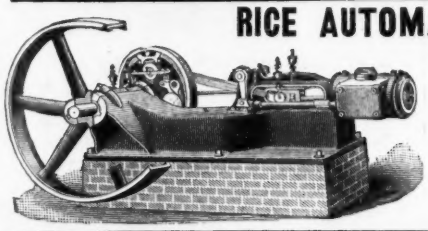

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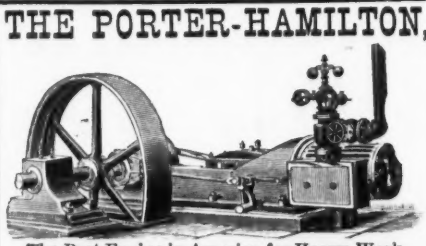

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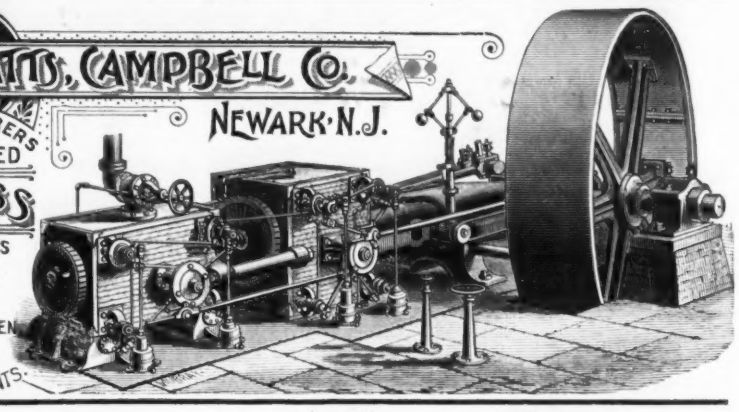

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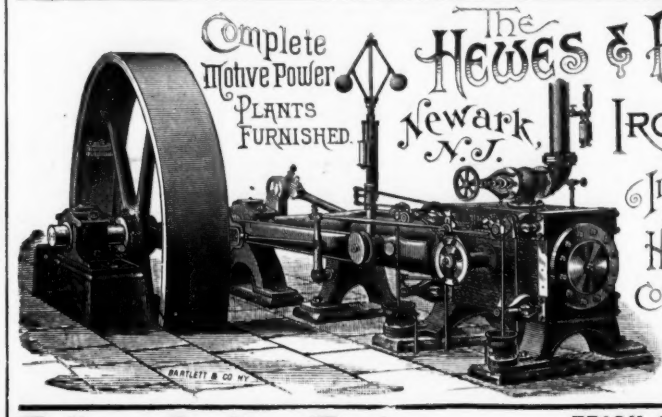

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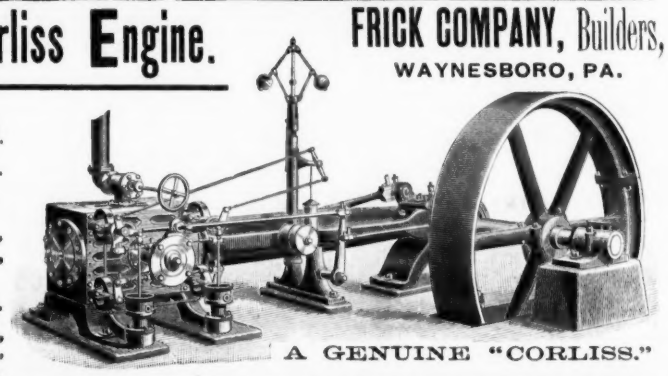

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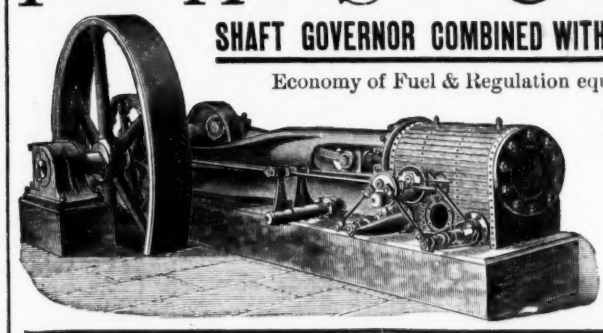

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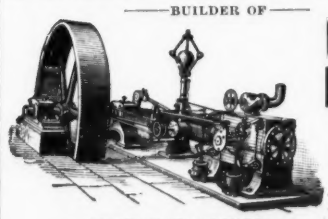

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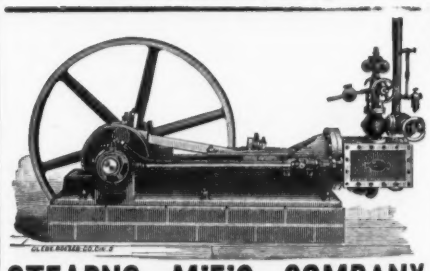

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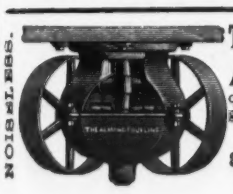

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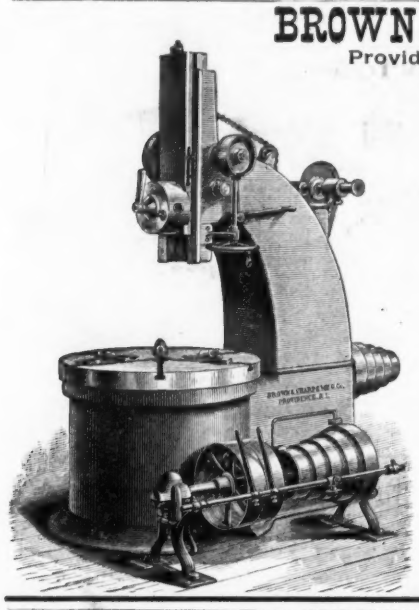

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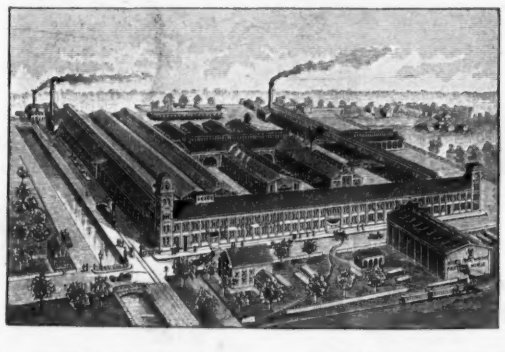

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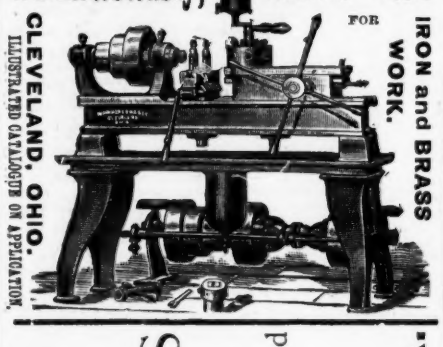

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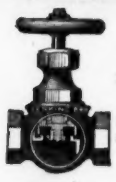

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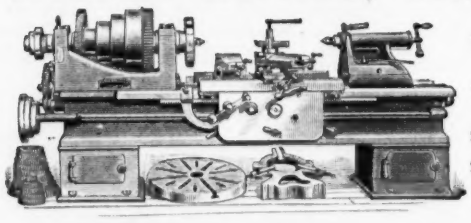

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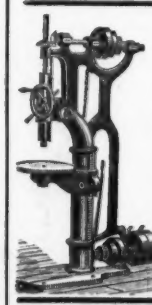

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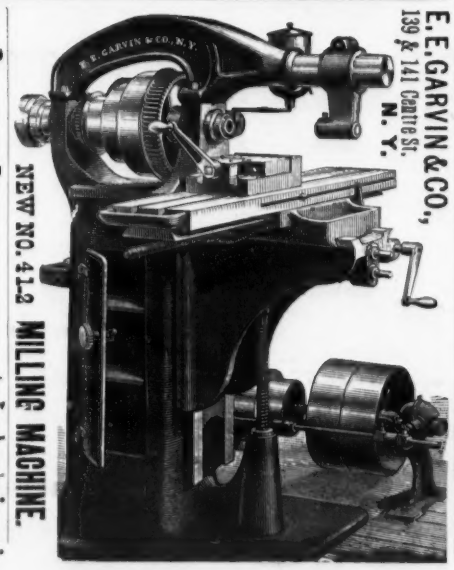

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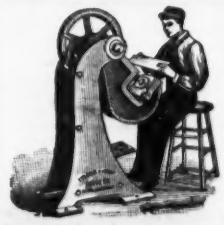

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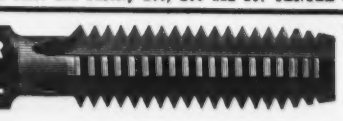

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